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University of Kansas
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Miscellaneous Publication No. 57

February 2, 1973

A Systematic Review of the Teiid Lizards, Genus *Bachia,* with Remarks on *Heterodactylus* and *Anotosaura*

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University of Kansas
Lawrence
1973

University of Kansas Publications, Museum of Natural History

Editor: Linda Trueb
Managing Editor: William E. Duellman

Miscellaneous Publication No. 57
pp. 1-47; 15 figures
Published February 2, 1973

Museum of Natural History
University of Kansas
Lawrence, Kansas 66044
U.S.A.

Printed By
University of Kansas Printing Service
Lawrence, Kansas

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INTRODUCTION

Bachia is one of three genera in the microteiid section of the family Teiidae having no external ear; the other two genera are *Anotosaura* and *Heterodactylus*. The 15 species of *Bachia* are similar in body shape, size, and frequently in color and color pattern. The body and tail are extremely elongated and the limbs relatively short in all species. The species of *Bachia* exhibit differences in external structural features, size of limbs, and numbers of fingers and toes.

Species of *Bachia* are inhabitants of semi-arid, subtropical and tropical habitats where there is an abundance of ground litter (forest floor) or soft sandy loam soils with abundant cactus litter (benches above Río Marañón at 500 m).

When I initiated a study of the lizard genus *Phyllodactylus* of South America at Lima, Perú, in 1968, I was immediately confronted with many lizards that I could not identify. One of these was a series of worm-like lizards *(Bachia)* from the Amazonian slopes of the Río Marañón. Further examination of the samples taken from the Río Marañón flood plain revealed the existence of possible hybridization between two species, *Bachia intermedia* and *B. barbouri* (Dixon, 1972). The absence of hind limbs in one species, degenerate limbs in the other, the presence or absence of certain head scales, the arrangement of other cephalic squamation, aroused my interest in the possible evolutionary pathways, function and behavior of these species. Therefore, I initiated a study of all of the available material of the known species of the genus, with the hope that a detailed study of the various populations would reveal why some species possess prefrontals, supraoculars, interparietals, internasals, and four toes on each limb, whereas others lack these features or possess various combinations of them.

The study, at times, became entangled in purely taxonomic problems involving literature; there were other problems, such as loss of type material, absence of comparative material, and loss of specimens through the mails. Nevertheless, the final result was the accumulation of data on some 600 specimens of *Bachia* from throughout its known distribution, and the formulation of several interesting evolutionary trends.

Historical Resumé

Writings pertaining to the species of the teiid genus *Bachia* are, in the modern sense, chaotic. Total taxonomic confusion has prevailed since the earliest inadequate description of the species *flavescens* by Bonnaterre (1789), which, at best is poorly described; this description is based on an illustration given by Lacepede in 1789. Prior to 1940, thirteen generic names were proposed for various species of *Bachia*. Short notes on the distribution and/or taxonomy of several species of *Bachia* are scattered through the literature of the past 75 years. Some of the more pertinent notes are those of Peracca (1896), Loveridge (1933), Parker (1928, 1935a), Crawford (1931), Daniel (1955), Brongersma (1956), Cunha (1958) and Vanzolini (1961a).

Boulenger (1885, 1887) did not recognize the current generic name *Bachia* Gray (1845) and grouped ten species into three genera—*Scolecosaurus* Boulenger (1885), *Cophias* Fitzinger (1843) and *Ophiognomon* Cope (1868). Concurrently he placed seven generic names into the synonymies of these genera. Boulenger did not know that three of the species were based upon Lacepede's (1789) figure on plate 32. Thus, he was the first to perpetuate a mistake that has permeated the literature until 1970, when Peters and Donoso-Barros reduced the three names to strict synonyms.

Garman (1892) showed that the genus *Cophias* was preoccupied and that *Bachia* Gray (1845) was the earliest available name for the genus. Ruthven (1925)

discussed the squamation of those species recognized in the genus *Cophias* by Boulenger (1885). He divided the species into two groups of *Bachia* based upon Boulenger's (1885) division of the genus *Cophias* into two sections. One group was characterized by quadrangular dorsals, whereas the other was distinguished by hexagonal dorsals; Ruthven called the first group "*cophias,*" and the second "*dorbignyi.*" Like Boulenger, Ruthven failed to describe the species correctly; he stated that *Bachia lineata* and *Bachia heteropa* have quadrangular dorsals, whereas in fact, they do not. Each of the mistakes in identification and/or characters of the species from the earliest descriptions has been perpetuated in part to the present time.

Burt and Burt (1931) added another species *(Bachia barbouri)* and attempted to rectify some of the mistakes made by earlier authors. They perpetuated Boulenger's (1903) error by stating that *Bachia lineata* had quadrangular dorsals, and therefore placed it in the "*cophias*" group where it does not belong. Burt and Burt (1931) were the first to correct the systematic position of *Bachia heteropa.* Other authors failed to notice that in Boulenger's (1887) addenda and corrigenda to the "Catalogue of the Lizards . . ." he redescribed *heteropa* from an examination of the type, and described a new species, *Lepidosternon boettgeri,* for the species he had called *heteropa* in 1885.

Vanzolini (1961b) described an additional species *(Bachia scolecoides)* and correctly allocated the genus *Scolecosaurus* Boulenger (1885) and *Apatelus* Amaral (1935) to the synonymy of *Bachia,* thereby adding five additional species to the genus. He summarized the major characters of the species, and indicated that two species were intermediate between Ruthven's (1925) "*cophias*" and "*dorbignyi*" groups, thus questioning the advisability of recognizing Ruthven's species groups.

Thomas (1965a) discussed the status of *Bachia alleni, B. trinitatis* and *B. pallidiceps* in northeastern South America. He showed that *trinitatis* and *alleni* are conspecific, relegated *alleni parviceps* to the synonymy of *alleni alleni,* and discussed the status of *Bachia cuvieri* (Fitzinger, 1826). He maintained that Barbour (1914, 1933) was correct in suggesting that, because *Bachia cuvieri* was from an unknown locality and the type lost, the name should be held as *incertae sedis* pending the availability of additional material. Burt and Burt (1931) indicated that the name applied to a population of *Scolecosaurus alleni* from the island of Grenada, West Indies, because the characters mentioned briefly in the original description could be associated with that population. Subsequently Barbour (1933) indicated that Burt and Burt did not have all the facts. On the basis of his examination of the three specimens available to Duméril and Bibron (1839), Barbour decided that three species were represented by their redescription of *Chalcis cuvieri.* Barbour (1933) stated further that Duméril and Bibron (1839) gave South America, specifically "Colombie," as the range of *Scolecosaurus cuvieri.* At that time New Grenada or Colombia included what is now Venezuela, Colombia, Panamá, Ecuador, Perú, and Bolivia. According to Barbour, one specimen represented *Scolecosaurus alleni* (MNHN 2836), one *Scolecosaurus trinitatis* (MNHN 2837), and one *Scolecosaurus pallidiceps* (MNHN 7051). If any one of the specimens represented *Scolecosaurus cuvieri,* it would be the specimen relegated to *Scolecosaurus alleni* because of the medial contact of the prefrontals (Barbour, 1933).

The only character of any value in the original description of *Brachypus cuvieri* by Fitzinger (1826) is the presence of four toes on anterior and posterior limbs. *Bachia panoplia, B. Scolecoides,* and *B. alleni* have four toes on each limb. All three species are easily separated on the basis of a number of characters; only re-examination of the holotype will definitely establish the

identity of *Bachia cuvieri*. Since the type is lost (formerly in the Naturhistorisches Museum, Wien), I propose that the currently recognized species of "four toed" *Bachia* be retained at their specific level, because their holotypes are extant, available, and their specific names are in current use. *Bachia cuvieri* will remain *incertae sedis* until the type is rediscovered.

Peters and Donoso-Barros (1970) followed Vanzolini's (1961b) arrangement, leaving the genera *Scolecosaurus* and *Apatelus* in the synonymy of *Bachia*. They recognized 19 species and four subspecies of *Bachia*, and for the first time formulated a key for all currently recognized taxa. Peters and Donoso-Barros (1970) pointed out that the trivial names *flavescens, cophias* and *tridactylus* are all based upon the figure of plate 32 of Lacepede (1789). All three have the same "Iconotype" and the latter two are strict synonyms of *flavescens* (Bonnaterre). Boulenger (1885) recognized *Cophias tridactylus* and *Cophias flavescens*, but indicated that *tridactylus* possesses an interparietal whereas *flavescens* does not. The type description of *Chalcides flavescens* (Bonnaterre, 1789) is brief, with a poor illustration, and no indication of the type of head scales. Boulenger (1885) further confused the issue by stating that *Cophias flavescens* has an undivided hind limb, whereas Bonnaterre (1789) definitely stated that the hind limb of *Chalcides flavescens* bears three, clawed toes. It seems obvious that Boulenger's description of *Cophias flavescens* is based upon specimens from the Guianas *(Bachia monodactylus)*, as indicated in his list of specimens examined following the description.

Daudin (1802:267) described *Chalcides tridactylus* and *C. monodactylus* in the same paper, and apparently had specimens on hand of one or both forms. Even though he based the description of *C. tridactylus* on the figure on plate 32 of Lacepede (1789), he indicated that *C. tridactylus* possessed an interparietal. Of some 600 specimens of *Bachia* examined, I have found only one specimen that possesses three toes on each foot and an interparietal. Daudin must have either seen the specimen illustrated by Lacepede or corresponded with him about its essential characters and incorporated these into his description of *C. tridactylus*.

Regardless of the actual circumstances leading to Daudin's (1802) description of *C. tridactylus*, a population does exist that essentially fits his description. Since the name *Bachia flavescens* (Bonnaterre, 1789) applies to a population having three toes on each foot, and the only extant specimen having three toes on each foot also possesses an interparietal, I assume the specimen illustrated by Lacepede had an interparietal. If my assumptions are correct, then the trivial name *tridactylus* is indeed, a strict synonym of *flavescens*, as pointed out by Peters and Donoso-Barros (1970).

The trivial names that I assign to *Bachia* are listed in table 1.

The Status of *Ophiognomon* Cope

Cope (1868) described the microteiid genus *Ophiognomon*, type species *trisanale*, and distinguished it from *Bachia* by the absence of the frontonasal scale. He later (1874) described the genus *Propus*, type species *vermiformis*, and separated it from *Ophiognomon* by the absence of a hind limb, more numerous scales and mutual contact of the second pair of chin shields. Peters (1872) described the genus *Hapalolepis*, type species *abendrothi;* apparently he was unaware of Cope's (1868) description of *Ophiognomon*. Boulenger (1885) noted the similarities of the three genera and placed *Propus* and *Hapalolepis* as strict synonyms of *Ophiognomon*. This arrangement has been followed to the present time.

I have examined the holotypes of all three species, and 69 additional specimens. I find few differences in the variation in scutellation exhibited by the 72 specimens of *Ophiognomon* and 450 specimens of *Bachia*. The only character

TABLE 1. Alphabetical Synonymy of the Species of *Bachia*.

Trivial Name, Original Generic Name, Author, Date	Current Name
abendrothii (Hapalolepis) Peters, 1871	*B. trisanale*
alleni (Scolecosaurus) Barbour, 1914	*B. heteropa*
anomala (Bachia) Roux, 1929	*B. heteropa*
barbouri (Bachia) Burt and Burt, 1931	*B. barbouri*
bicolor (Heteroclonium) Cope, 1896	*B. bicolor*
boettgeri (Lepidosternon) Boulenger, 1885	*B. flavescens*
bresslaui (Apatelus) Amaral, 1935	*B. bresslaui*
cophias (Chamaesaura) Schneider, 1801	*B. flavescens*
cuvieri (Brachypus) Fitzinger, 1826	*incertae sedis*
daudini (Colobus) Merrem, 1820	*B. monodactylus*
dorbignyi (Chalcides) Duméril and Bibron, 1839	*B. dorbignyi*
flavescens (Chalcides) Bonnaterre, 1789	*B. flavescens*
heteropa (Chalcides) Lichtenstein, 1856	*B. heteropa*
intermedia (Bachia) Noble, 1921	*B. intermedia*
lineata (Bachia) Boulenger, 1903	*B. heteropa*
marcelae (Bachia) Donoso-Barros and Garrido, 1964	*B. heteropa*
monodactylus (Chalcides) Daudin, 1802	*B. monodactylus*
pallidiceps (Brachypus) Cope, 1862	*B. pallidiceps*
panoplia (Bachia) Thomas, 1965	*B. panoplia*
parkeri (Bachia) Ruthven, 1925	*B. monodactylus*
peruanus (Cophias) Werner, 1901	*B. peruana*
schlegeli (Chalcides) Duméril and Bibron, 1839	*B. flavescens*
scolecoides (Bachia) Vanzolini, 1961	*B. scolecoides*
talpa (Bachia) Ruthven, 1925	*B. talpa*
tridactylus (Chalcides) Daudin, 1802	*B. flavescens*
trilineatus (Chalcides) Peters, 1872	*B. monodactylus*
trinitatis (Scolecosaurus) Barbour, 1914	*B. heteropa*
trisanale (Ophiognomon) Cope, 1868	*B. trisanale*
vermiformis (Propus) Cope, 1874	*B. trisanale*

that may be of importance in separating the two genera is the absence of the frontonasal scale in *Ophiognomon*. However, certain specimens of *Bachia peruana* either lack or have a very small frontonasal scale, with the nasal scales enlarged and in contact behind the rostral. In *Ophiognomon*, the frontonasal space has been filled by the expansion of the nasal and frontal scales. This trend is also evident in *Bachia*, thereby lending support to the idea that *Ophiognomon* and *Bachia* are congeneric.

All essential characters of scutellation of *Ophiognomon* (scales around midbody, dorsals, ventrals, gulars, presence or absence of contact between labial and parietal and between second pair of chin shields) fall within the variation exhibited by *Bachia*. Thus, I propose that *Ophiognomon* Cope (1868) be placed in the synonymy of *Bachia* Gray (1845).

THE STATUS OF *Anotosaura* AMARAL AND *Heterodactylus* SPIX

A survey of the major museums in Europe and the United States revealed the existence of only 15 specimens of *Heterodactylus*. This genus is comprised of two species, *H. imbricatus* Spix (1825)

and *H. lundii* Reinhardt and Lütken (1861); neither type seems to be extant. Boulenger (1885) gave detailed descriptions of both species, and I have examined 14 of 15 specimens (11 *imbricatus*, 3 *lundii*).

Amaral (1933) indicated that his new genus *Anotosaura*, type species *collaris*, was distinct from *Heterodactylus* in having the nostril in the center of the nasal scale, presence of prefrontals, smooth dorsal scales, absence of occipital scales, and relatively short limbs. I have been unable to examine the unique specimen of *A. collaris*, but apparently all three genera (*Anotosaura, Bachia, Heterodactylus*) are closely related (Table 2). The teeth on the dentary of *Heterodactylus* are bicuspid or tricuspid (linear) and are considerably larger than those of *Bachia*. In addition, *Heterodactylus* has lanceolate scales on the body and tail that are four to five times longer than wide, strongly keeled, and quite different than most species of *Bachia*. Only *Bachia bresslaui, B. panoplia* and *B. scolecoides* approach the latter condition. All three species are smaller in snout-vent length than *Heterodactylus*, and lack the small occipital and nuchal scales present in *Heterodactylus* (Fig. 1). *Bachia panoplia* has lanceolate, keeled, ventral body scales, whereas *Heterodactylus, Anotosaura, Bachia bresslaui*, and *B. scolecoides* have quadrangular, smooth ventrals. All three species of *Bachia* show a reduction in the number of toes on the limbs (4-4, *panoplia, scolecoides*; 1-1 *bresslaui*) whereas *Heterodactylus* has a digital number of 4-5 or 5-5. However, one may find as much scale variation among species of *Bachia* as between *Bachia* and *Heterodactylus*.

Bachia panoplia and *B. scolecoides* seem to be closely related to *Heterodactylus*, with *B. bresslaui* a slightly more advanced form, modified for burrowing. However, without concrete osteological and myological data to corroborate these relationships, I propose retaining *Heterodactylus* and *Anotosaura* as separate genera until an anatomical study can be completed. This suggested study is presently underway by Dr. William Presch, University of California, Berkeley. The general distribution of the three genera is given in figure 2.

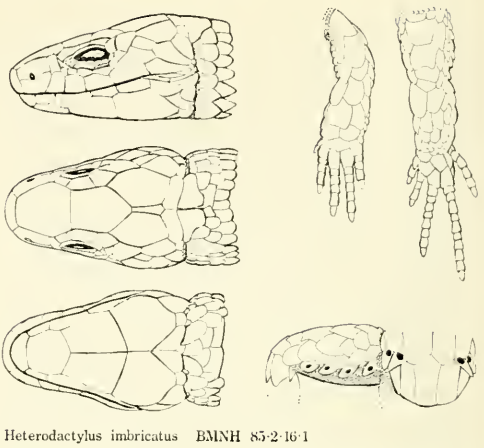

FIGURE 1. Lateral, dorsal, and ventral view of the head, dorsal view of the limbs and ventral view of the pelvic region of *Heterodactylus imbricatus*.

METHODS AND MATERIALS

The methods utilized in the analysis of variation of squamation in populations of *Bachia* consisted of standard techniques for determining the mean, standard deviation and standard error. Characters examined for statistical analyses were as follows: 1) number of scales around middle of body, counted midway between axilla and groin (= SAB); 2) number of dorsal scales from the occiput to above vent (= dorsals); 3) number of ventral scales between pectoral shield and preanal shields (= ventrals); 4) number of ventral scales between collar fold (immediately behind angle of jaw) and pectoral shield (= gulars); and 5) number of longitudinal rows of quadrangular ventral scales. The number of supraoculars was counted for each side and written 2-2, 2-3, or however they varied. Similar counts were made of supercilliaries, labials, toes, femoral and/or preanal pores. The number of preanal shields usually varied according to how

TABLE 2. A comparison of the essential external features of the microteiid genera *Anotosaura*, *Heterodactylus* and *Bachia* (data on *Anotosaura* taken from Amaral, (1933). Abbreviations are H, L, Q, K, S = hexagonal, lanceolate, quadrangular, keeled, smooth; — = absent; + = present.

Character	*Anotosaura*	*Heterodactylus*	*Bachia*
Maximum snout-vent length	37 mm	114 mm	107 mm
Tooth type	?	tricuspid	simple cone
Body scale type	H,S	L,K	L,H,Q,K,S,
Femoral pores	2-2	3-3 to 5-5	0-0 to 2-2
Preanal pores	2-2	1-1 to 2-2	0-0 to 2-2
Forelimb toes	5-5	4-4 to 5-5	1-1 to 4-4
Hind limb toes	5-5	5-5	0-0 to 4-4
Prefrontals	+	—	+ —
Interparietal	+	+ —	+ —
Enlarged nuchals	—	+	—
Chin shields	3 pr	2 pr	2 pr
Pairs of chin shields in medial contact	3	1 or 2	1 or 2
Pairs of chin shields reaching oral border	3rd	—	— or 2nd
Supraoculars	3-3	3-3	0-0 to 3-3
Superciliaries	2-2	3-3 to 5-5	1-2 to 3-4
Scales around midbody	23	28-36	22-47
Dorsals	25	34-41	33-56
Ventrals	18	24-27	24-43
Gulars	6	6	6-10
Supralabials	6	5 to 6	4-4 to 6-6
Infralabials	5	4 to 6	4-4 to 6-6
Preanal shields	9	3-5	3-6
External ear	—	—	—
Collar fold	+	+, weak	+

enlarged scales were arranged (i.e., longitudinal or transverse). When three shields are present, the division is longitudinal; when four or five are present the division is transverse, and the middle shield is usually divided into halves or into thirds.

The shape of the body scale was utilized to determine group relationships. All populations having lanceolate, keeled, imbricate scales are placed in the *bresslaui* group, and those with all quadrangular, smooth, juxtaposed scales are placed in the *flavescens* group. Numbers of hexagonal, smooth, and imbricate scales present on the dorsum and sides of the body distinguish the *dorbignyi* and *heteropa* groups. In this study, the lanceolate scale is one that is usually keeled, four to five times longer than wide, and with strongly pointed proximal and distal ends. The hexagonal scale is smooth, and two to three times as long as wide with somewhat rounded or obtusely pointed ends. The quadrangular scale is smooth and usually rectangular.

The presence or absence of certain scales were noted and used to determine interpopulational relationships. Such obvious scales as prefrontals, frontonasal,

FIGURE 2. Distribution of the closely related microteiid genera *Anotosaura, Bachia* and *Heterodactylus* in South America and Panamá.

interparietal, supraoculars, superciliaries, and their size, position, or absence are useful in determining generalized and advanced conditions for certain populations. The reduction in number of toes, and the size or absence of limbs are also used in assessment of generalized or advanced conditions.

Reduction in size and number of toes is difficult to determine. The feet are very small in *Bachia,* and any reduction in size or loss of toes can only be determined by the use of a high power, binocular dissecting microscope. The terminal ends of degenerate toes vary from a single apical scale, a divided apical scale, or two to three distinct apical scales covering minute toes. Whenever a single apical scale is present, the limb itself is much reduced, styloform, or tubercular in appearance.

The position and size of chin shields are also utilized in determining interpopulation relationships. The first pair of chin shields is always in broad contact medially. The second pair may or may not be in contact medially and in most species, usually does not reach the oral border. In only one specimen is the second pair in contact medially and also reaching the oral border.

Little variation is evident in the number of labials, but contact of the fourth or fifth supralabial with the parietals is an important character in some species. The general shape of the snout is uniform for most species, but *B. talpa* and *B. bicolor* have depressed and somewhat protruding rostrals. The bodies of all *Bachia* are somewhat compressed dorsoventrally, extremely long, and the fore- and hind limbs positioned far apart. The tail is usually one and one-third to two times longer than the body. No ratios were taken on the length of the body compared to the length of the head or limbs because of the poor preservation of many of the specimens.

All major museums in the United States, Europe, and South America were canvassed for their holdings of *Bachia* and *Heterodactylus.* Some 651 specimens of *Bachia* and *Heterodactylus* were located, and 520 of these were examined. Three partial skeletons were examined, one skull, and one cleared and stained specimen.

Specimens were borrowed from the following museums and individuals: American Museum of Natural History (AMNH), Academy of Natural Sciences, Philadelphia (ANSP), British Museum (Natural History) (BMNH), California Academy of Science (CAS), Field Museum of Natural History (FMNH), Florida State Museum, University of Florida (UF), University of Kansas Museum of Natural History (KU), Los Angeles County Museum of Natural History (LACM), Rijksmuseum van Natuurlijke Historie, Leiden (RMNH), Louisiana State University Museum of Zoology (LSUMZ), Museum of Comparative Zoology, Harvard (MCZ), Merriam Museum, University of Texas, Arlington (MM), Museum of Vertebrate Zoology (MVZ), Museu de Zoologia, Universidade da São Paulo (MZUSP), Museum National d'Histoire Naturelle, Paris (MNHN), Texas Cooperative Wildlife Collection (TCWC), University of Michigan Museum of Zoology (UMMZ), United States National Museum (USNM), James A. Peters (JAP), Richard Thomas (RT).

Acknowledgments

I thank Howard Campbell, William Duellman, Alice Grandison, Harry Greene, Jean Guibé, Marinus Hoogmoed, Alan Leviton, Edmond Malnate, Hymen Marx, James Peters, Douglas Rossman, Richard Thomas, P. E. Vanzolini, David Wake, Charles Walker, Ernest Williams, John Wright and Richard Zweifel for permitting me to examine specimens in their care.

I also thank William E. Duellman, William Presch and P. E. Vanzolini for criticizing the manuscript. This paper would not have been completed without the aid of Fred Hendricks, James Kroll and Carl Lieb.

EVOLUTIONARY TRENDS IN THE GENUS BACHIA

The generalized scale pattern in *Bachia* is one in which the dorsal scales are lanceolate, keeled, and imbricate, and the ventrals are usually quadrangular and smooth. The head shields consist of a normal complement of nasals, frontonasal, frontal, paired parietals, interparietal, 3 supraoculars and 3 superciliaries. The limbs are moderately developed for walking, with four toes on each limb. In slightly specialized species, the scale pattern consists of wider, smoother hexagonal scales, which are less pointed and imbricate. There has been no change in the number of head shields, or toes, but the limbs are somewhat shorter and less developed. In more specialized species, the body scales become more quadrangular in shape in some groups; head shields are successively lost with a corresponding increase in the size of the nasals, frontal, and frontonasal. The trend towards reduction is marked by disappearance of the prefrontals first, followed by loss of the interparietal, supraoculars, toes and eventually, the frontonasal shield and the hind limb.

The reduction in number of head shields, toes, and eventual loss of the frontonasal and hind limb are adaptive modifications for fossorial habits. The successive loss of head shields and toes tends to follow distinct and independent patterns within each of the species groups *(bresslaui, dorbignyi, heteropa, flavescens).* Although each group has its complement of generalized species, there is a definite trend towards fossorialness in at least one of its species or subspecies.

However, one must not lose sight of the genetic variability in the various populations of *Bachia* that might give rise to variations yet to be explored by evolutionary pathways. One population may lose its supraoculars, interparietal and prefrontals prior to loss or reductions in size and number of toes and limbs; whereas another population may retain its full complement of head shields but have loss or deduction in numbers of toes and limbs. Modification of body scales (*i.e.,* becoming quadrangular and juxtaposed, allowing for greater flexibility in body movement) and atlas-axis-cervical vertebrae (*i.e.,* for stronger vertical thrust in head movements for burrowing through leaf litter) may be the primary method of evolutionary modification for fossorial existence in *Bachia.* Unfortunately, few specimens are available for examination of the latter character. The rate of evolutionary change in one set of characters for one set of environmental conditions may or may not affect the same rate of change in other characters (*i.e.,* modification of neck vertebrae for more vertical thrust, but retention of limbs and toes with unmodified pelvic girdle), as it were, carrying out one evolutionary modification but not "placing all of its eggs in one basket."

Based upon body scale patterns (i.e., lanceolate, hexagonal, quadrangular, (Fig. 3a) *Bachia* seems to have evolved from a *Heterodactylus*-like ancestor. The *bresslaui* group *(bresslaui, scolecoides, panoplia)* all show some relationship to *Heterodactylus* (*i.e.,* lanceolate, keeled dorsals), with *B. scolecoides* appearing more closely related to *Heterodactylus* than the other two species of the group. All three species share body scale type, presence of an interparietal, and femoral pores in common with *Heterodactylus.*

The ancestor to this group is the probable progenitor to all species of *Bachia.* Two species appear to be subterranean, leaf litter inhabitants *(scolecoides, panoplia),* whereas the presence of a reduced head scale number and degenerate limbs in the third *(bresslaui)* suggest that it is fossorial. Neither life history information nor large series of individuals are available for study.

On the basis of the presence of an interparietal, prefrontals, and number of toes, the nearest relative of the *bresslaui* group would be the *heteropa* group.

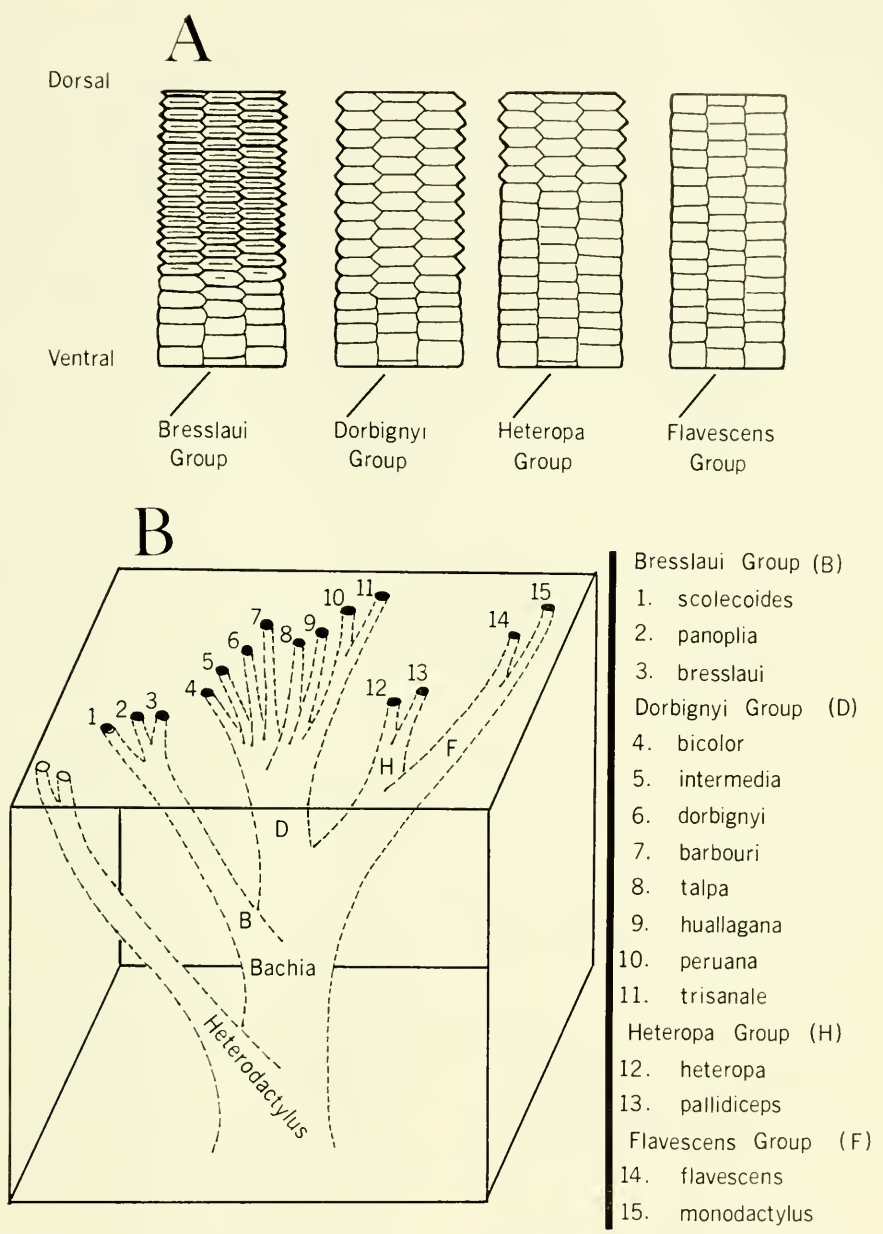

FIGURE 3. A. Scale pattern of the four species groups of *Bachia*. B. A proposed phylogenetic arrangement of the genus *Bachia*.

However, the type of body scales in the *heteropa* group is quite unlike that in the *bresslaui* group. The dorsal scales of the *heteropa* group are hexagonal, smooth and imbricate, and the lateral and ventral scales are quadrangular, smooth and juxtaposed. The *dorbignyi* group has dorsal and lateral hexagonal scales, smooth and imbricate, and only the ventrals are quadrangular and juxtaposed.

Collectively, the *dorbignyi* group shows a general reduction in number of head scales and toes, and a tendency

toward fossorialness. *Bachia bicolor* appears to be the most generalized species of the group, with *B. trisanale* the most advanced. However, there are variations within each species toward fossorial adaptations that mask their interspecific phylogenetic relationships.

Most species of the *dorbignyi* group have lost the prefrontals, supraoculars and interparietal (except *barbouri*), and in one case *(trisanale)* the frontonasal. In addition, the latter group shows a uniform trend toward reduction in number of toes on the forelimb.

The *heteropa* group seems to have given rise to the *flavescens* group, sharing several characters of the head and body squamation. The primary differences between these groups is the presence of all quadrangular body scales and complete loss of the prefrontals in the latter group. My hypothesis of the phylogenetic relationships of *Bachia* and *Heterodactylus* is shown in figure 3b.

Bachia Gray 1845

Chalcides Bonnaterre, 1789:66 [Type species.—*Chalcides flavescens* Bonnaterre, 1789, (preoccupied by *Chalcides* Laurenti, 1768)].

Chalcis Merrem, 1820:75 [Type species.—*Chalcides tridactylus* Daudin, 1802, (preoccupied by *Chalcis* Fabricus, 1787)].

Colobus Merrem, 1820:76 [Type species.—*Seps monodactylus* Daudin, 1802, (preoccupied by *Colobus* Illiger, 1811)].

Brachypus Fitzinger, 1826:20 [Type species.—*Brachypus cuvieri* Fitzinger, 1826, (preoccupied by *Brachypus* Swainson, 1824)].

Cophias Fitzinger, 1843:20 [Type species.—*Chalcides dorbignyi* Duméril and Bibron, 1839, (preoccupied by *Cophias* Merrem, 1820)].

Microdactylus (Tschudi MS) Agassiz, 1844:28, not of Fitzinger, 1843, (preoccupied by *Microdactylus* Geoffroy, 1809).

Bachia Gray, 1845:58 [Type species.—*Chalcides dorbignyi* Duméril and Bibron, 1839].

Ophiognomon Cope, 1868:100 [Type species.—*Ophiognomon trisanale* Cope, 1868].

Hapalolepis Peters, 1871:399 [Type species.—*Chalcides (Hapalolepis) abendrothii* Peters, 1871].

Propus Cope, 1874:70 [Type species.—*Propus verminformis* Cope, 1874, (preoccupied by *Propus* Oken, 1816)].

Herpetochalcis Boettger, 1883:150 [Type species.—*Chalcides heteropus* Lichtenstein, 1856].

Scolecosaurus Boulenger, 1885:416 [Type species.—*Brachypus cuvieri* Fitzinger, 1826].

Sesquipes Cope, 1896:466 [Type species.—*Chalcides heteropus* Lichtenstein, 1856].

Heteroclonium Cope, 1896:466 [Type species.—*Heteroclonium bicolor* Cope, 1896].

Anisoclonium Cope, 1900:561 [Type species.—none designated].

Apatelus Amaral, 1935:249 [Type species.—*Apatelus bresslaui* Amaral, 1935, (preoccupied by *Apatelus* Mulsant and Rey, 1860)].

Generic Definition.—The microteiid genus *Bachia* comprises those populations of lizards having elongate snake-like bodies and tails, and short limbs; external ear absent; eyes reduced in size; lower eyelid with unsegmented window; ventral scales quadrangular, juxtaposed (except one species); hind limb frequently reduced to a styloform femur and tibia, often without visible toes and entire hind limb may be completely absent (for variation in squamation see table 3).

The osteology of the genus *Bachia* demonstrates adaptive modifications for burrowing. The following osteological description is based upon four members of the *dorbignyi* group *(barbouri, bicolor, intermedia, trisanale).*

Camp (1923) stated that the following conditions prevail in *Bachia:* Zygosphenal articulation supplementing ordinary zygapophyseal type is rudimentary or absent; three cervical ribs; interclavicle reduced to longitudinal bar; simple clavicles; none to one sternal fontanelle; scapular fenestra absent; first and second scapulo-coracoid fenestrae present and closed; 13 pairs of parasternal ribs; hyoid arch lacking second epibranchial; second ceratobranchial present.

In addition to Camp's (1923) observations, the following osteological features are characteristic of *Bachia:* 45 presacral vertebrae; three pairs of sternal ribs; one pair of xiphisternal ribs; full complement of pelvic elements in terrestrial species, reducing to single fusion of ilium, ishium and pubis in fossorial species lacking hind limbs; phalangeal formulae highly variable depending on

TABLE 3. Summary of the scales around body and dorsal and ventral scales of the species of *Bachia*. The range is given first, followed by mean, standard deviation, and standard error.

	N	Scales Around Body	Dorsals	Ventrals
scolecoides	15	36-40 x̄ 37.7 SD 0.94 ± 0.24	47-52 x̄ 49.6 SD 1.14 ± 0.29	36-42 x̄ 39.0 SD 1.58 ± 0.41
panoplia	12	43-47 x̄ 44.7 SD 1.34 ± 0.45	48-52 x̄ 50.1 SD 1.11 ± 0.37	36-38 x̄ 36.8 SD 0.78 ± 0.26
bresslaui	2	33-35 x̄ 34.0 – –	47-49 x̄ 48.0 – –	37-38 x̄ 37.5 – –
barbouri	57	26-31 x̄ 28.8 SD 1.11 ± 0.15	46-52 x̄ 49.0 SD 1.33 ± 0.18	34-39 x̄ 36.7 SD 1.15 ± 0.15
bicolor	21	27-31 x̄ 28.9 SD 0.99 ± 0.22	46-53 x̄ 49.7 SD 2.10 ± 0.45	34-40 x̄ 37.1 SD 1.82 ± 0.40
dorbignyi	53	23-28 x̄ 24.6 SD 1.17 ± 0.16	50-55 x̄ 52.9 SD 1.38 ± 0.19	37-42 x̄ 39.9 SD 1.27 ± 0.17
huallagana	18	24-30 x̄ 26.1 SD 1.68 ± 0.41	47-54 x̄ 49.2 SD 1.69 ± 0.41	35-42 x̄ 37.2 SD 1.55 ± 0.38
intermedia	63	28-35 x̄ 31.0 SD 1.36 ± 0.17	46-52 x̄ 49.4 SD 1.36 ± 0.17	33-38 x̄ 35.7 SD 1.38 ± 0.17
peruana	38	23-26 x̄ 25.1 SD 0.79 ± 0.14	53-56 x̄ 54.6 SD 0.81 ± 0.14	41-43 x̄ 42.0 SD 0.71 ± 0.12
talpa	3	25-27 x̄ 26.0 – –	47-51 x̄ 49.3 – –	36-38 x̄ 37.3 – –
trisanale	72	23-30 x̄ 26.2 SD 1.87 ± 0.23	47-55 x̄ 50.6 SD 1.84 ± 0.23	34-42 x̄ 37.7 SD 1.84 ± 0.23
heteropa	82	24-31 x̄ 28.4 SD 1.52 ± 0.17	38-49 x̄ 41.6 SD 1.92 ± 0.22	24-36 x̄ 27.0 SD 2.19 ± 0.25
pallidiceps	18	21-25 x̄ 22.9 SD 0.91 ± 0.22	43-48 x̄ 45.3 SD 1.35 ± 0.33	30-34 x̄ 31.6 SD 1.15 ± 0.27
flavescens	3	30-32 x̄ 31.0 – –	46-48 x̄ 47.3 – –	33-34 x̄ 33.3 – –
monodactylus	50	26-33 x̄ 29.2 SD 1.98 ± 0.29	47-53 x̄ 49.6 SD 1.66 ± 0.24	33-39 x̄ 35.5 SD 1.46 ± 0.22

fossorial adaptations in any particular species or populations of a species; atlas and axis modified for burrowing in the species examined, with atlas composed of three separate and distinct units (single median hypocentrum articulating with paired, unfused neural arches); axis possessing posteriorly projecting hypopophysis upon which *longus colli* muscles insert; neural spine of axis notched posteriorly to receive neural spine of third cervical vertebra; cranial elements somewhat modified for burrowing with broad premaxillary in contact with frontal, separating paired nasals; postorbital and postfrontal unfused and generally paralleling each other, not in close contact with jugal; postfrontal extremely long and thin, extending from orbit to posterior edge of fused parietals; quadrate short and stout; stapes large and plate-like; 10 scleral ossicles around each eye; 7-9 premaxillary teeth, 16-20 maxillary teeth, and 22-26 dentary teeth (totaled for both sides).

Content.—As defined here, the genus *Bachia* contains 15 species, of which four are polytypic, containing a total of 12 subspecies; the genus is divided into four species groups.

Distribution.—*Bachia* occurs in the lowland tropics and semi-arid foothills from northwestern Panamá southward to Gran Chaco, Paraguay. The genus occurs on Grenada, Grenadines, Trinidad, and Tobago, but is absent from the Pacific lowlands of South America (Fig. 2). Most records of occurrence are at elevations of less than 500 m, but one species is known to occur at elevations exceeding 1,500 m in the Tulumayo Valley of southcentral Perú.

Key to Species

The following key to the species of *Bachia* is based primarily on the various scale characters of the groups presented previously. The number of toes is not reliable in some species of *Bachia*; therefore, the number of toes is used only once in a primary couplet.

1. All midbody scales quadrangular 2
   All midbody scales not quadrangular 4
2. Interparietal scale absent 3
   Interparietal scale present ..... *flavescens*
3. Hind limb as long or longer than preanal shields, scales around midbody 26 or more ..... *monodactylus*
   Hind limb less than half the length of preanal shields, scales around body 24 ..... *species Q*
4. Ventral scales quadrangular, smooth 5
   Ventral scales lanceolate, keeled ..... *panoplia*
5. Dorsal scales lanceolate, keeled 6
   Dorsal scales hexagonal, smooth 7
6. Prefrontals present, fore and hind limb toes 4-4 ..... *scolecoides*
   Prefrontals absent, fore and hind limb toes 1-1 ..... *bresslaui*
7. Lateral body scales hexagonal 8
   Lateral body scales quadrangular 15
8. Interparietal scale absent 9
   Interparietal scale present ..... *barbouri*
9. Frontonasal scale usually present 10
   Frontonasal scale usually absent ..... *trisanale*
10. Second pair of chin shields not in contact medially 11
    Second pair of chin shields in contact medially 13
11. Three toes on the forelimb 12
    Four toes on the forelimb ..... *bicolor*
12. Second pair of chin shields separate third and fourth infralabials and reach oral border, five temporal scales ..... *talpa*
    Second pair of chin shields do not separate third and fourth infralabials nor reach oral border, three temporal scales ..... *huallagana*

13. Two supercilliaries, a supralabial touching the parietal 14
    Three supercilliaries, no supralabial touching parietal ..... *intermedia*
14. Fourth supralabial touching parietal ..... *peruana*
    Fifth supralabial touching parietal ..... *dorbignyi*
15. Two supercilliaries, SAB number usually less than 24 (x = 22.9) ..... *pallidiceps*
    Three supercilliaries, SAB number usually more than 24 (x = 28.4) ..... *heteropa*

SYSTEMATIC ACCOUNTS

The *Bachia bresslaui* Group

The *bresslaui* group is composed of three species, *bresslaui, scolecoides* and *panoplia,* none with recognized races. This group occupies the Amazonian drainages of the Rio Amazonas *(panoplia),* Rio Teles Pires *(scolecoides),* and the Rio Juruena *(bresslaui),* Brasil. *Bachia panoplia* is known only from the immediate vicinity of Manáus, Brasil, but may occur in one or more of the nearby river drainages that empty into the Rio Amazonas. All three species are allopatric with each other, but *panoplia* is sympatric with *monodactylus* of the *flavescens* group.

The *bresslaui* group comprises those populations having lanceolate, keeled, imbricate dorsal and lateral body scales (including the ventrals in *panoplia*), with quadrangular, juxtaposed ventrals; 2-2 femoral pores and 1-1 preanal pores in males; interparietal, supraoculars, and superciliaries present; prefrontals present (fused to anterior supraocular in *bresslaui*); digits normally four on each limb (one in *bresslaui*).

Bachia bresslaui (Amaral)

Figure 4

Apatelus bresslaui Amaral, 1935:250 [Holotype IB525, from the interior of the state of São Paulo, Brasil, collector unknown].
Bachia bresslaui—Vanzolini (1961b:200).

Range.—Known only from Utiariti, Rio Papagaio (tributary of Rio Juruena) Mato Grosso, Brasil (and possibly the state of São Paulo, Brasil, Vanzolini, 1966) (Fig. 5).

Diagnosis.—Dorsal and lateral body scales lanceolate, keeled, imbricate; ventral scales quadrangular, juxtaposed; all tail scales lanceolate, keeled, imbricate; prefrontals absent (fused to anterior supraocular); interparietal, frontonasal, nasals, parietals present; supraoculars 2-2; superciliaries 2-2; second pair of

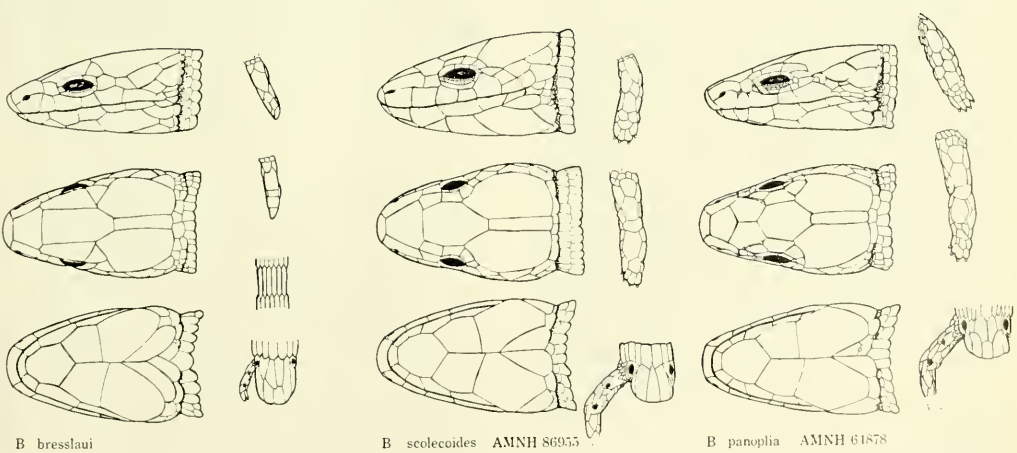

FIGURE 4. Lateral, dorsal, and ventral views of the head, dorsal view of the limbs and ventral views of the pelvic region of *B. bresslauii, B. scolecoides,* and *B. panoplia.*

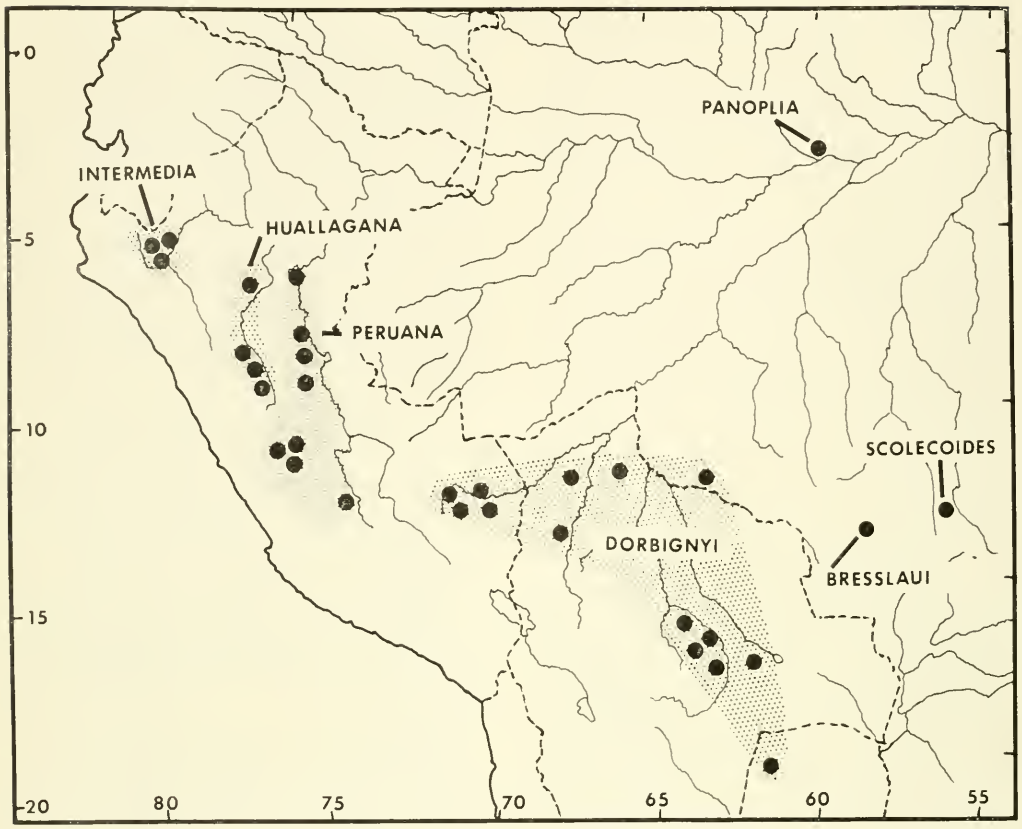

FIGURE 5. Distribution of *B. dorbignyi, B. peruana, B. huallagana, B. intermedia, B. bresslaui, B. scolecoides* and *B. panoplia* in west central South America.

chin shields in contact medially, not reaching oral border; femoral pores 1-1 or 2-2; preanal pores 1-1; anterior and posterior limbs reduced with a single apical scale resembling a toe; preanal shields 6 (not including 2 small lateral scales); SAB 33-35; dorsals 47-49; ventrals 38; gulars 9; maximum snout-vent length 75 mm.

Variation.—I have examined one (MZUSP 10300) of the two known specimens. Based on the original description (Amaral, 1935), Vanzolini's (1916b) redefinition of the type, and Vanzolini's (1966) description of the second known specimen, there is little evidence of variation in this species.

Remarks.—This species is the most advanced member of the *bresslaui* group, based on the reduction of toes, size of limbs, and head scales. Although no information on the natural history is available, the nature of its digits suggests a fossorial existence.

Bachia scolecoides Vanzolini

Figure 4

Bachia scolecoides Vanzolini, 1961b:202 [Holotype.—MZUSP 3293, from Rio Teles Pires, Mato Grosso, Brasil; Mr. H. Sick collector].

Range.—Known only from the type locality (Fig. 5).

Diagnosis.—Dorsal and lateral body scales lanceolate, keeled and imbricate; ventral scales quadrangular and juxtaposed; all tail scales similar to dorsals; prefrontals present but without medial contact; interparietal, frontonasal, nasals and parietals present; supraoculars

2-2; superciliaries 3-3; second pair of chin shields in medial contact but not reaching oral border; femoral pores 2-2; preanal pores 1-1; anterior and posterior limbs moderately developed with four toes on each foot; preanal shields 3-4; SAB 36-40; dorsals 47-52; ventrals 36-42; gulars 8; maximum snout-vent length 78 mm.

Variation.—Little variation was noted in the type series (Vanzolini, 1961b). Females varied in snout-vent length from 50 to 69 mm males from 48 to 78 mm. The number of supraoculars (2-2), superciliaries (3-3) and toes (4-4) were constant in the sample. The transverse rows of gular scales are usually 8 (9 in one specimen); enlarged supralabials 5-5, infralabials 4-4; labials not in contact parietals; SAB are 36-40 ($\bar{x}$ 37.7); dorsals, 47-52 ($\bar{x}$ 49.6); ventrals, 36-42 ($\bar{x}$ 39.0).

Coloration.—The dorsal color pattern of body and tail consists of three black to dark brown lines (one median, two paravertebral) separated by light tan to yellowish brown interspaces. The sides are dark brown to black with the venter lighter than the sides. The dark dorsal lines are present on the head, but may be broken into a series of irregular lines or spots.

Remarks.—This species is known only from the type series (15 specimens). Natural history information is lacking. Additional collecting along and between the Rio Teles Pires and Rio Juruena may reveal intermediates or hybrids between *bresslaui* and *scolecoides*.

Bachia panoplia Thomas

Figure 4

Bachia panoplia Thomas, 1965:18 [Holotype AMNH 64877, from Manáos, Amazonas, Brasil; E. T. Gilliard collector].

Range.—Known only from the type locality (Fig. 5), and Timbo, Comisaria de Vaupés, Colombia.

Diagnosis.—Dorsal, lateral and ventral body and tail scales lanceolate, keeled and imbricate; prefrontals with medial contact; interparietal, frontonasal, nasals and parietals present; supraoculars 3-3; superciliaries 3-3; second pair of chin shields in medial contact but do not reach oral border; femoral pores 2-2; preanal pores 1-1, absent in females; anterior and posterior limbs moderately developed with four toes on each limb; preanal shields 5 to 6; SAB 43-47; dorsals 48-52; ventrals 36-38; gulars 8; maximum snout-vent length 85 mm.

Variation.—Little variation was noted in the number of head shields. Only one specimen had a 3-4 combination in superciliaries. Four toes on the forelimb were constant and three toes on the hind limb occurred twice in 10 specimens. The gular rows were eight in all specimens. The preanal shields are 5-6 ($\bar{x}$ 5.3) (one small scale on each side not counted); SAB are 43-47 $\bar{x}$ 44.7, SD 1.34 ± 0.45; dorsals, 48-52 ($\bar{x}$ 50.1, SD 1.10 ± 0.37); ventrals, 36-38 ($\bar{x}$ 36.8, SD 0.78 ± 0.26).

Coloration.—Dorsal color pattern usually consists of a wide olive brown, middorsal stripe (9-11 scale rows wide), extending from nape to tail; outer edge of dorsal stripe occasionally dark olive, forming an obscure dorsolateral dark line; sides of body somewhat darker than dorsum; venter pale yellow, or tan; head with a large olive, lobate figure from parietals to anterior edge of prefrontals; posterior edge of each dorsal scale edged with dark olive, giving an obscure "banding" effect to each scale row.

Remarks.—This species is known only from the type series, four additional specimens from the type locality, and one specimen from Colombia. No natural history information is available. The specimen from Colombia was removed from the stomach of a snake, *Pseudoboa coronata*. Additional collecting along the southern rivers flowing north into the Amazon may reveal sympatry between *panoplia* and other members of the group. *Bachia monodactylus* has been taken at Manáos but actual sympatry between *panoplia* and *monodactylus* has not been recorded. Based on the size of the limbs and number of toes, *B. pano-*

plia appears to be a leaf litter inhabitant while *monodactylus* is primarily fossorial.

The *Bachia dorbignyi* Group

The *dorbignyi* group is composed of eight species, one with three subspecies *(dorbignyi, barbouri, bicolor, huallagana, intermedia, peruana, talpa, trisanale trisanale, trisanale abendrothi, trisanale vermiforme).* This group contains the largest number of species, of which the majority are allopatric. Two species, *bicolor* and *talpa,* are restricted to northern and central valleys of Colombia, and separated from other species of the group by the northern Andes. The remainder of the species (except *trisanale*) occur in isolated river valleys along the eastern edge of the Peruvian and Bolivian Andes. *Bachia trisanale* is widespread in the lowlands of Perú and Ecuador.

This group comprises those populations of *Bachia* having hexagonal, smooth, imbricate scales on the dorsal and lateral surfaces of the body and tail; quadrangular, juxtaposed scales on the ventral surfaces of the body; hexagonal scales on the ventral surface of the tail, although occasionally the proximal ventral surface may have a few quadrangular scales; a styloform hind limb (except *barbouri* and *trisanale,* where it may be absent or tubercular); usually three toes on each forelimb (four in *bicolor,* two in *barbouri,* one to three in *trisanale*); supraoculars absent (occasionally one present in *intermedia*); superciliaries usually 2-2 (occasionally one to three); usually fourth or fifth supralabial in contact with parietal (no contact in *intermedia*); one or two preanal pores in males (sometimes very small, indistinct in *peruana*); second pair of chin shields usually not in contact with oral border (in contact in *talpa, barbouri,* and occasionally *bicolor*); second pair of chin shields in medial contact (no contact in *talpa* and *huallagana*), and occasionally in *trisanale*); frontonasal shield present (absent in *trisanale,* reduced in size or absent in *peruana*); interparietal absent (present in *barbouri*); prefrontals absent.

Bachia intermedia Noble

Figure 6

Bachia intermedia Noble, 1921:142 [Holotype. —MCZ 14630, from Perico, Departamento Cajamarca, Perú, G. K. Noble collector].

Range.—Known only from the Río Chinchipe and Río Marañón valleys from Perico on the north and Bellavista on the south (Fig. 5).

Diagnosis.—Dorsal and lateral body scales hexagonal, smooth and imbricate; ventral scales quadrangular, juxtaposed; tail scales similar to dorsals; nasals, frontonasal, parietals present; nasals not in contact medially behind rostral; prefrontals, interparietal, and supraoculars absent; no supralabial/parietal contact; forelimbs small with three toes; hind limb styloform with one or two apical scales resembling toes; superciliaries usually three; preanal pores 1-1 in males, absent in females; SAB 28-35 ($\bar{x}$ 31.0); dorsals 46-52 ($\bar{x}$ 49.4); ventrals 33-38 ($\bar{x}$ 35.7); gulars 7-9 ($\bar{x}$ 8.2); maximum snout-vent length 67 mm.

Variation.—The head squamation is fairly consistent. One of 63 specimens has a small azygous scale between the posterior medial contact of the parietals; numbers of superciliaries are 3-3 in 56 specimens, 2-3 (3) and 2-2 (4); those specimens with two superciliaries have a small supraocular wedged between the second and third superciliary, but failing to reach the orbital border; second pair of chin shields in medial contact in all specimens, but do not reach oral border; transverse rows of gular scales number seven in one specimen, eight (51), nine (11); supralabials and infralabials are 6/5 in all specimens; preanal shields number three in 3 specimens, four (59), five (1); longitudinal rows of quadrangular ventrals are 4-9 ($\bar{x}$ 6.2); number of toes on forelimb are 3-3 in 62 specimens, 4-4 in one; hind limb always styloform with single apical scale that may be divided.

Coloration.—Dorsal color pattern a broad, yellowish tan stripe about 10 scale

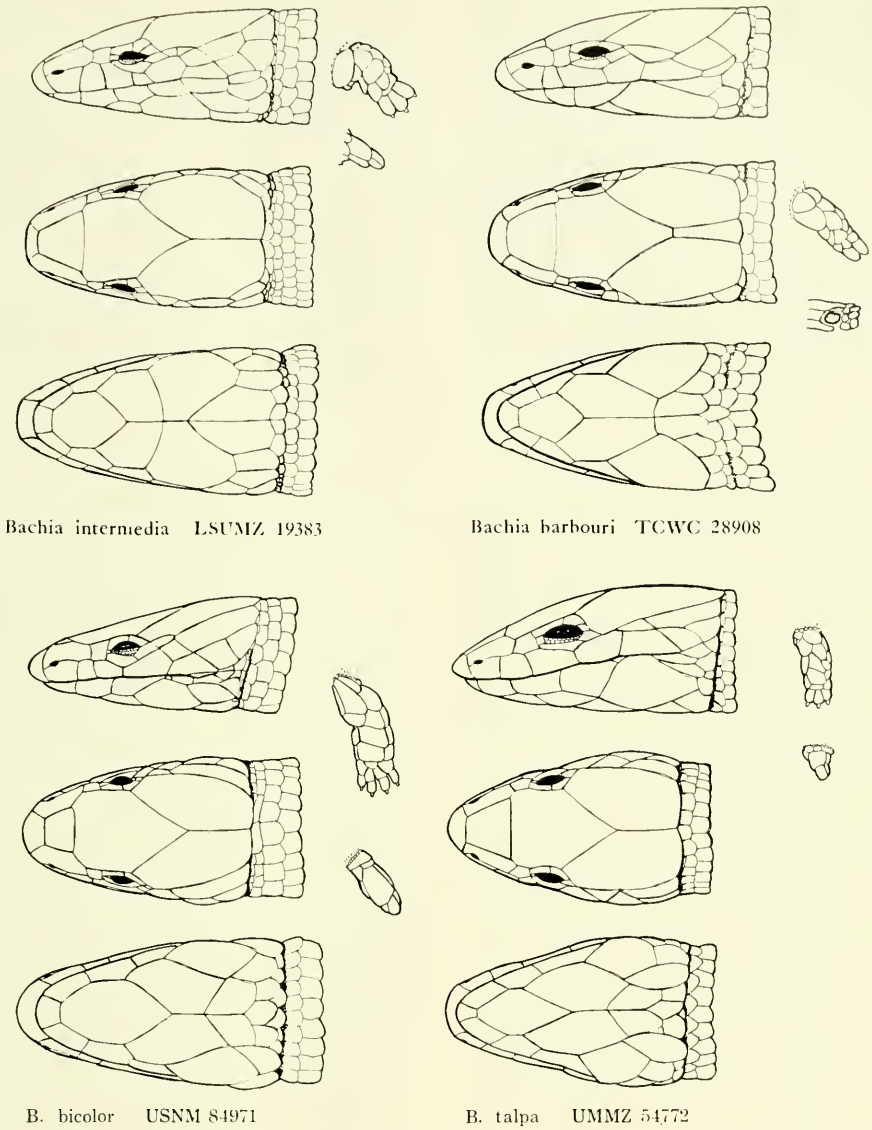

FIGURE 6. Lateral, dorsal, and ventral views of the head, dorsal view of the limbs of *B. intermedia, B. barbouri, B. bicolor* and *B. talpa.*

rows wide from occiput to near tip of tail, with three dark brown to black lines superimposed over the stripe; the median black line usually straight edged and continuous, paravertebral lines usually a series of dashes; all stripes and lines continue anteriad to frontonasal scale; sides of head, body and tail black to dark brown; venter dark brown, but occasionally lighter than sides of body.

Remarks.—Loveridge (1933) gives some individual variation data for a series of *intermedia* from the type locality vicinity. Dixon (1972) found natural hybrids between *intermedia* and *barbouri.* Neither species, following examination of additional specimens, revealed additional hybrids.

Bachia intermedia has been found on dry foothill slopes and in slightly moist conditions along river valleys. It has been taken beneath fallen cacti, mesquite trees, strangler figs, and grass clumps. This species lays two eggs, probably during November, December, and January, judging from the egg maturity of females taken during this period.

Burt and Burt (1931) indicate that the series of *intermedia* paratypes they examined had two toes on each hind foot. Actually the terminal scale is divided and only one degenerate toe is present beneath the scale.

Bachia barbouri Burt and Burt

Figure 6

Bachia barbouri Burt and Burt, 1931:318 [Holotype.—AMNH 28437, from Perico, Departamento Cajamarca, Perú; C. K. Noble collector].

Range.—Known only from the Río Chinchipe, Río Marañón and Río Utcubamba valleys of northwestern Perú (Fig. 9).

Diagnosis.—Dorsal and lateral body scales hexagonal, smooth and imbricate; ventral scales quadrangular, juxtaposed; tail scales similar to dorsals; nasals, frontonasal, interparietal, parietals present; prefrontals and supraoculars absent; frontonasal large, separating nasal scales; fifth supralabial in contact with parietal in 30 percent of the sample; forelimbs small with two toes; hind limb usually absent but occasionally a very small tubercule, present, preanal pores 1-1 in males, absent in females; SAB varying from 26-31 ($\bar{x}$ 28.8); dorsals 46-52 ($\bar{x}$ 49.0); ventrals 34-39 ($\bar{x}$ 36.7); gulars 8-10 ($\bar{x}$ 8.9); maximum snout-vent length 68 mm.

Variation.—The head shields of this species are remarkably constant. Presence of the interparietal, two superciliaries, six supralabials, five infralabials, and second pair of chin shields reaching oral border does not vary in 57 specimens. One of 57 specimens lacks medial contact between second pair of chin shields; interparietal completely splits parietals in 70 percent of sample; fifth supralabial touches parietal on one side in 6 specimens, both sides in 10, neither side in 41; toes on forelimbs are 2-2 in 55 specimens, 1-2 in one, and 2-3 in one; hind limbs absent in 56 specimens, a small tubercule present in one. Preanal shields number three in 3 specimens, four (44), five (10); transverse rows of gular scales number eight in 13 specimens, nine (33), ten (11); number of ventral longitudinal scale rows is 6-12 ($\bar{x}$ 8.7).

Coloration.—The dorsal head pattern of *B. barbouri* consists of a large arrow-shaped, black mark, beginning on the anterior edge of frontal and extending to the posterior edge of parietals; open end of arrow facing posteriorly; usually median black spot or short line inserted between open end of arrow and nape; dorsolateral and lateral surface of head black; occasionally black spot in center of frontonasal; rostral usually white but occasionally black line extending around rostral from nasal to nasal.

Dorsal pattern from nape to near tip of tail consists of a cream to white stripe about 10 scale rows wide, with three longitudinal black lines superimposed over light stripe; black lines usually discontinuous, broken into a linear series of dots or dashes; sides black, venter black or occasionally dark brown.

Remarks.—During 26-28 November 1968, John Wright and I collected a series of *barbouri* from the vicinity of Bellavista and Bagua Grande, Perú. One specimen was taken beneath a fallen *Cereeus* above the Río Maránõn flood plain; 12 were found beneath drift debris on the flood plain. Eleven others were found beneath leaf litter and fallen cacti near a small stream. An additional seven were found under decaying agave relatively high on a hillside. Richard Thomas (pers. com.) found one in a termite nest.

Gravid females taken contained two eggs in various stages of development. One egg, ready to be deposited, measured 4.7 x 15.4 mm.

Natural hybridization between *barbouri* and *intermedia* was noted by Dixon (1972). The hybrids were taken beneath rotten, moist logs in xeric scrub vegetation.

Bachia bicolor (Cope)

Figure 6

Heteroclonium bicolor Cope, 1896:466 [Syntypes.—AMNH 9544-45 from vicinity of Bogotá, Departamento Cundinamarca, Colombia; collector unknown].

Heterodonium bicolor Cope, 1899:9 [Identical description published posthumously by Percy Moore].

Bachia bicolor—Ruthven, 1922:63.

Range.—This species is known only from northern and central Colombia, and extreme western Venezuela (Fig. 7). Literature records from Cuenta, Honda (Ruthven, 1925), Tucurinca (Ruthven, 1922), San Gil (Dunn, 1944), Colombia and Sierra de Perija, near Tukuko (Aleman, 1953), Venezuela are probably referable to *Bachia bicolor*.

Diagnosis.—Dorsal and lateral body scales hexagonal, smooth and imbricate; ventral scales quadrangular, juxtaposed; tail scales similar to dorsals; nasals, frontonasal, parietals present; interparietal, prefrontals and supraoculars absent; usually no contact between supralabials and parietals; two superciliaries; preanal pores 1-1 in males, absent in females; forelimb small with four toes; hind limb styloform with one to three apical scales resembling toes; SAB 27-31 ($\bar{x}$ 28.9); dorsals 46-53 ($\bar{x}$ 49.7); ventrals 34-40 ($\bar{x}$ 37.1); gulars 7-9 ($\bar{x}$ 8.0); maximum snout-vent length 75 mm.

Variation.—No variation was observed in the absence of the interparietal, prefrontals or number of forelimb toes. Only one of 21 specimens had a small supraocular on each side in addition to the superciliaries. The fourth supralabial in contact with the parietal on both sides in 2 specimens, one side in one, and neither side in 18. The second pair of chin shields are never in medial contact and reach oral border in about 50 percent of the sample; supralabials and infralabials 5/5 in all; preanal shields three in 19 specimens, four (2); longitudinal rows of quadrangular ventral scales are 4-8 ($\bar{x}$ 6.95).

Coloration.—Bachia bicolor has three distinct dorsal color patterns, although the head color pattern is rather constant. The head is brown to blackish with two thin yellowish tan to cream lines beginning above eye on outer edge of frontal, passing posteriorly along outer edge of parietals to nape. Dorsal body pattern consists of two or three black or brownish black lines one half to one scale row wide, extending from the nape to near tip of tail; median dark line occasionally absent; median line (when present) and paravertebral lines straight edged, irregular, or broken into a linear series of short dashes; dorsal lines separated by light tan to tan brown stripe about two scale rows wide; light stripes (fused into a single light stripe five scale rows wide when median dark line absent) are frequently freckled with dark brown; dorsolateral light stripe usually uniform in color; upper side of body usually as dark as dark dorsal lines, fading into brownish color of venter; chin and throat usually uniform brown.

Remarks.—Bachia bicolor was first described in a footnote by Cope (1896). Percy Moore apparently overlooked this description when he published Cope's (1899) posthumous paper on "Contributions to the herpetology of New Granada and Argentina." The latter paper contains a better "original" description and excellent figures of *bicolor*. Cope's (1899) figure of the preanal plate and adjacent body scales does not show the hind limb, unless the two large scales shown represent the limbs. However, Cope's text states that a hind limb is present and is 1.3 mm in length.

Ruthven (1922) reports a series of *bicolor* came from beneath logs and rocks in a dry forest. Valdivieso and Tamsitt (1963) found a specimen beneath a rock in a cow pasture.

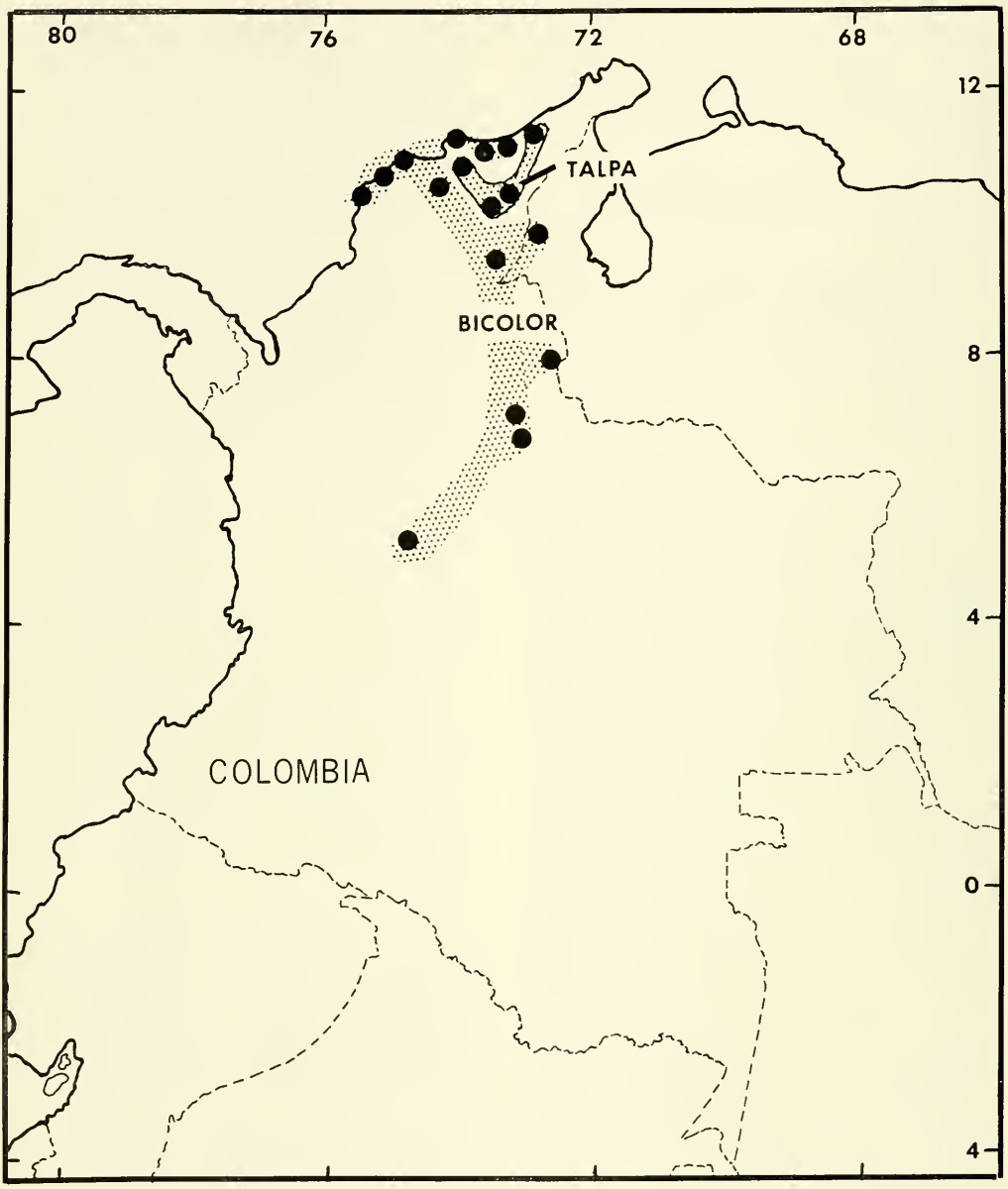

FIGURE 7. Distribution of *B. bicolor* and *B. talpa* in Colombia and Venezuela.

Bachia talpa Ruthven

Figure 6

Bachia talpa Ruthven, 1925:101 [Holotype.—UMMZ 54771 from Valledupar, Sierra Santa Marta, Colombia; A. G. Ruthven collector].

Range.—Known only from extreme northern Colombia, along the west, south and east sides of the Sierra Santa Marta (Fig. 7).

Diagnosis.—Dorsal and lateral body scales hexagonal, smooth and imbricate; ventral scales quadrangular, juxtaposed; tail scales similar to dorsals; nasals, frontonasal, parietals present; interparietal, prefrontals, supraoculars absent;

fourth supralabial occasionally contacts parietal; preanal shields three; preanal pores absent; superciliaries two; forelimbs small with three toes on each foot; hind limb tubercular with one apical scale that may be divided; SAB 25-27 ($\bar{x}$ 26.0); dorsals 47-51 ($\bar{x}$ 49.3); ventrals 36-38 ($\bar{x}$ 37.3); gulars 9; maximum snout-vent length 65 mm.

Variation.—Three specimens, paratypes, were examined. Apparently no specimens exist in museum collections other than the type series. By incorporating the information from the original description with my data, the number of forelimb toes, superciliaries, preanal shields, labials, and gulars are constant. Numbers of longitudinal rows of quadrangular ventrals are 8-10 ($\bar{x}$ 9.1); second pair of chin shields never in medial contact, but reach oral border in all specimens; apical scale of hind limb tubercle may be single or divided.

Coloration.—Color patterns of dorsum consists of three distinct, longitudinal dark brown to black lines (one median, two paravertebral); dark lines are one half to one scale row wide and extend from nape to near tip of tail; sides of body dark brown, upper edge almost black and forming a somewhat distinct line, giving an appearance of five dark lines on dorsum; lower sides slightly lighter in color than sides; venter dark brown to almost black and darker than side of body; dark dorsal lines separated by yellowish tan, tan or light brown stripes one and one half to two scale rows wide; all lines and stripes extend cephlad to level of frontonasal; side of head dark brown; snout light brown; throat and chin brown.

Remarks.—Ruthven (1922) reports the type series came from beneath logs in a dry forest, and dry parts of flood plain forests.

Bachia huallagana new species

Figure 8

Holotype.—USNM 192997, adult male.

Type Locality.—San José de Tocache (= Tocache Nuevo) 80° 12′ S, 76° 27′ W, 450 m., on Río Huallaga, Provincia Mariscal Caceres, Departamento San Martín, Perú, collected by Wade C. Sherbrooke, 2 February 1967.

Paratypes.—USNM 192996, 192998-193004 topotypes; USNM 192993-95, 193005-07, Tingo María 670 m, Departamento Huánuco, Perú; AMNH 56566, upper Biabo Valley, Departamento San Martín, Perú; UF 28143-44, 27.4 km SSE Aucayacu 650 m, Departamento Huánuco, Perú (Fig. 5).

Diagnosis.—A member of the *dorbignyi* group with hexagonal, smooth and imbricate scales on the dorsal and lateral surfaces of body; ventral scales quadrangular and juxtaposed; tail scales similar to dorsals; interparietal, prefrontals and supraoculars absent; nasals, frontonasal, frontal and parietals present; nasals not in medial contact behind rostral; superciliaries 2-2; forelimb small with three toes on each foot; hind limb tubercular; second pair of chin shields never in medial contact nor reaching oral border; usually fourth supralabial in contact with parietal; preanal shields usually four; preanal pores 2-2 in males, 1-1 or absent in females; SAB 24-30 ($\bar{x}$ 26.1); dorsals 47-54 ($\bar{x}$ 49.2); ventrals 35-42 ($\bar{x}$ 37.2); gulars 7; labials usually 5/4; maximum snout-vent length 73 mm.

Description of Holotype.—Rostral slightly more than twice as wide as high; frontonasal narrow anteriorly, one-half as broad as posterior end; supralabials five on each side; first supralabial indented dorsally by nostril lying between it and nasal; fourth supralabial highest, in contact with parietal on each side; fifth supralabial elongate and somewhat triangular in shape; frontal in brief contact with posterior edge of nasals; parietals two, large; supraoculars and prefrontals absent; superciliaries two on each side, anterior one largest; loreal rectangular, in contact with frontal, superciliary, preocular, nasal and second and third supralabials; preocular one on each side; suboculars two on each side, anterior one elongate and narrow, pos-

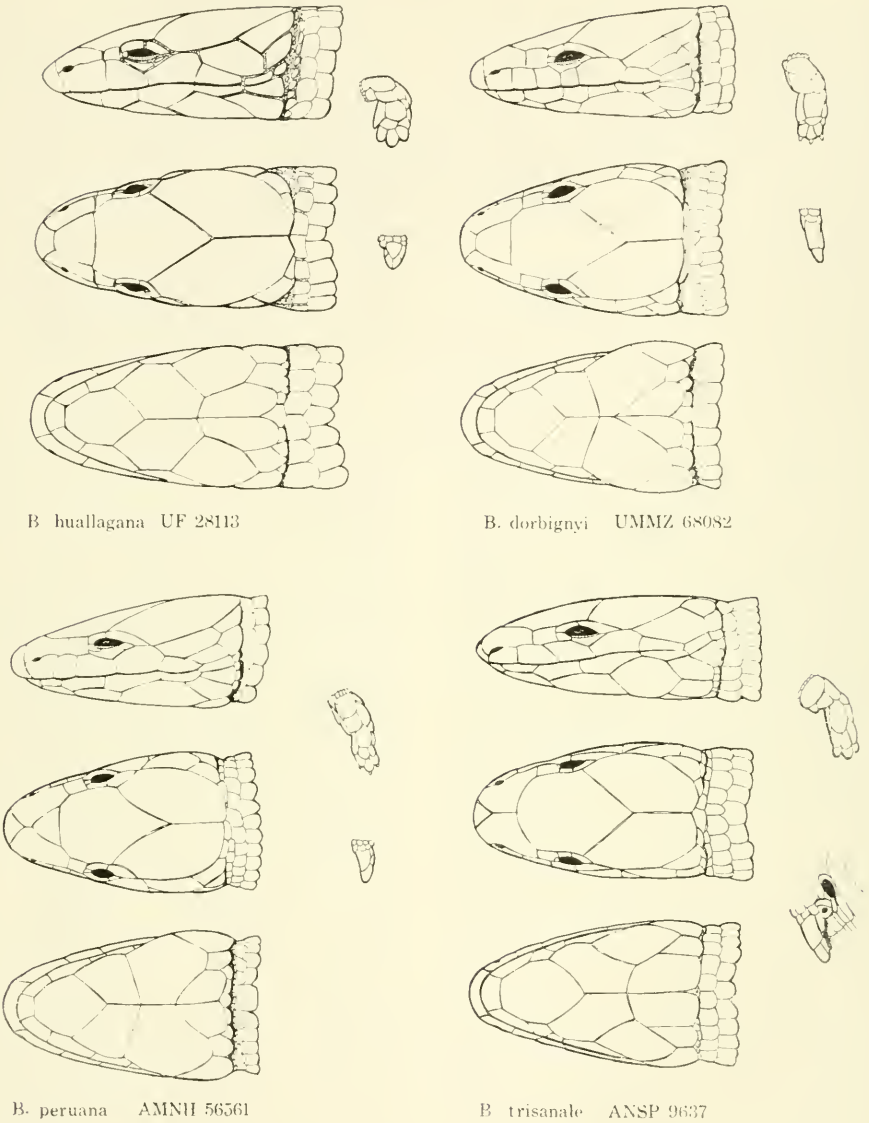

FIGURE 8. Lateral, dorsal and ventral views of the head, dorsal view of the limbs of *B. huallagana, B. dorbignyi, B. peruana,* and *B. trisanale.*

terior one small, almost granular; postocular fused to fourth supralabial; temporals three on each side; mental trapezoidal; postmental large, septangular, followed by two pair of enlarged chin shields, second pair widely separated medially and almost reaching oral border; infralabials four; union between third and fourth reduced because of intrusion of second chin shield; tympanum absent; collar fold present; enlarged pectoral shields two; enlarged preanal shields three, middle one divided in half; transverse rows of dorsal scales above pectoral shields and above preanal shields three; transverse dorsal rows from occiput to above vent 49; scales around midbody 27; six ventral rows quadrangular, remainder hexagonal, smooth and imbricate; transverse gular scale rows

from collar fold to pectoral shield seven, transverse scale rows between pectoral and preanal shields 36; transverse scale rows from vent to tip of tail 98; forelimb with five longitudinal scale rows from body to toes; three clawed toes beneath three apical scales on forelimb; hind limb tubercular with a longitudinally divided apical scale; preanal pores 2-2.

Dorsal and lateral head surfaces blackish brown with two broken yellowish tan lines between last superciliary and collar fold; dorsum brownish black with two well defined dorsolateral black lines extending from nape to tip of tail; median, irregular blackish line extending from nape to about middle of tail; dark dorsal lines superimposed over yellowish tan ground color about 10 scale rows wide; ground color between paravertebral dark lines heavily mottled with dark brown; broad lateral blackish stripe extends from collar fold to tip of tail, becoming slightly lighter in color ventrolaterally; venter brown to blackish brown.

Measurements in mm: Total length 149.0; snout-vent length 60.0; head length 7.1; head width 5.2; forelimb length 2.3; hind limb length 0.5; midbody width 4.2; axilla-groin length 45.0.

Variation.—Details of color pattern and cephalic squamation of paratypes are similar to holotype. The third supralabial is divided in one specimen, creating six supralabials, of which the fifth has parietal contact. One specimen has the first and second supralabials fused on one side creating four supralabials, the third in contact with a parietal. One specimen has supralabial in contact with parietal only on one side and another not in contact on either side. Number of superciliaries are 2-2 in 17 specimens, 1-2 in one. Number of gulars (7) and longitudinal rows of quadrangular ventrals (6) are constant in the sample. Preanal shields vary from 3 to 5, three occurring 4 times, four (13), five (1). Preanal pores are 2-2 in males, 1-1 or absent in females; hind limb always tubercular and forelimb with 3 toes on each foot. For statistical analyses of SAB, dorsals and ventrals see table 3.

Comparisons.—*Bachia huallagana* differs from all species in the *dorbignyi* group (except *talpa* and *bicolor*) by absence of medial contact between second pair of chin shields. It differs from *bicolor* by having three forelimb toes rather than four, and males with two preanal pores on each side rather than one. The new species differs from *talpa* by the presence of four preanal pores and no contact between second pair of chin shields and oral border, rather than no preanal pores and broad contact between second pair of chin shields and oral border. *Bachia huallagana* differs from *talpa* and *bicolor* by having a relatively short rostral that barely extends beyond lower jaw while *talpa* and *bicolor* have depressed heads with an expanded rostral extending well beyond the lower jaw.

Remarks.—Fred Thompson (pers. com.) indicated that specimens were found within decaying logs about one meter in diameter in tropical rainforest at Aucayacu. Wade Sherbrooke (pers. com.) stated that his series from the Tingo María area were found in the soil and humus beneath decaying logs in the Agraria de la Selva University botanical garden. Some of Sherbrooke's specimens were maintained in captivity for a short while. During daylight periods they remained beneath the soil, but after dark they emerged and crawled about on the surface, indicating nocturnal tendencies. Sherbrooke indicated that the majority of the topotypic series were taken by following a bulldozer clearing a road to an airstrip.

This species is named for the major river drainage (Río Huallaga) from which the majority of specimens have been taken.

Bachia dorbignyi (Duméril and Bibron)

Figure 8

Chalcides dorbignyi Duméril and Bibron, 1839:462 [Holotype.—MNHN 2841 from Santa Cruz, "Chile"; collector unknown (corrected to Santa Cruz de la Sierra, De-

partamento Santa Cruz, Bolivia, by Vanzolini, 1961b)].
Bachia dorbignyi—Gray, 1845:58.
Cophias dorbignyi—Boulenger, 1885:417.
Bachia dorbignyi—Garman, 1892:2.

Range.—Known from Rio Manoel Carreia, extreme western Brasil (Vanzolini, 1961b), Grand Chaco Region, northern Paraguay (Hellmich, 1960), low and moderate elevations of Bolivia, and extreme southeastern Perú (Fig. 5).

Diagnosis.—Dorsal and lateral body scales hexagonal, smooth and imbricate; ventral scales quadrangular, juxtaposed; tail scales similar to dorsals; nasals, frontonasal, frontal, parietals present, interparietal, prefrontals, supraoculars absent; rostral frontonasal with short contact, separating nasal scales; fifth supralabial contacts parietal (never the fourth); forelimbs with 3 toes on each foot; hind limb styloform with one apical scale that may be divided; superciliaries 2-2; preanal pores 2-2 in males, 1-1 or absent in females; preanal shields usually 4; SAB 23-28 ($\bar{x}$ 24.6); dorsals 50-55 ($\bar{x}$ 52.9); ventrals 37-42 ($\bar{x}$ 39.9); gulars 6-7; maximum snout-vent length 80 mm.

Variation.—Little variation was observed in the cephalic squamation. Superciliaries 2-2 in 50 specimens, 2-3 (2), 3-3 (1); fifth supralabial contacts parietal on both sides in 45 specimens, one side (4), neither side (4); second pair of chin shields in medial contact in 49 specimens, separated by small azgyous scale (4); gular scales seven in 49 specimens, six (4); preanal shields three in 2 specimens, four (51); longitudinal quadrangular ventral rows four in 7 specimens, five (9); six (37); toes on forelimbs 2-3 in 1 specimen, 3-3 (52); hind limb invariably styloform with single apical scale; supralabials and infralabials always 6/5.

Coloration.—The dorsal head pattern of *B. dorbignyi* consists of a large arrow-shaped mark pointing anteriad, extending from anterior edge of frontal to posterior edge of parietals; small black line or series of small spots between open ends of arrow and nape connecting to median dark line on body; dorsolateral and lateral surfaces of head brownish black to black; two yellowish tan lines extend from parietals to anterior end of frontal, fusing to form light colored frontonasal and rostral; dorsolateral surface of head and arrow-shaped mark frequently spotted with tan; chin and throat uniform light to dark brown.

Dorsum with broad yellowish tan or cream stripe, 10 scale rows wide, from nape to near tail tip; three brownish black to black lines (median and two paravertebral) superimposed over light stripe from nape to near tail tip; edges of dark lines straight and seldom broken into series of dashes or spots; sides of body dark brown to black, venter brown to brownish black and usually a little lighter than sides.

Remarks.—Natural history information is lacking for this species. Ruthven (1922) recorded *dorbignyi* from the Sierra Santa Marta of Colombia, but later (1925) described the same sample as a new species *(talpa).* Werner (1900) considered *dorbignyi* and *peruana* to be closely related, but Ruthven (1925) and Burt and Burt (1931) suggested possible synonymy. Vanzolini (1961b) suggested that *peruana* was probably not a strict synonym of *dorbignyi,* but intimated a conspecific relationship.

I find a significant difference (3 SE) between the two species in the number of dorsals and ventrals, and no overlap in the number of labials and the specific labial in contact with the parietal. Even though the two populations are allopatric, I consider them to be species.

Bachia peruana (Werner)

Figure 8

Cophias peruana Werner, 1901:5 [Holotype.—DM 1698 (destroyed during World War II) from Chanchamayo, Perú; collector unknown].
Bachia peruana—Ruthven, 1925:105.

Range.—Known from the western valleys of the middle tributaries of the Río Ucayali and the flood plain of Río Ucayali from Chanchamayo on the south to Orellana on the north, Perú (Fig. 5).

Diagnosis.—Dorsal and lateral body scales hexagonal, smooth and imbricate; ventral scales quadrangular, juxtaposed; tail scales similar to dorsals; nasals, frontal, parietals and frontonasal present (frontonasal occasionally absent); prefrontals, interparietal and supraoculars absent; frontonasal usually reduced (occasionally absent) allowing contact between nasal scales in about 25 percent of sample; fourth supralabial always contacting parietal (never fifth); forelimbs small with three toes on each foot; hind limb styloform with single apical scale; superciliaries 2-2; preanal pores 1-1 (frequently indistinct), absent in females; preanal shields usually 4; SAB 23-26 ($\bar{x}$ 25.1); dorsals 53-56 ($\bar{x}$ 54.6); ventrals 41-43 ($\bar{x}$ 42.0); gulars 6-7; maximum snout-vent length 107 mm.

Variation.—The cephalic squamation shows little variation. One of 38 specimens has 3-3 superciliaries; fourth supralabial always in contact with parietal on both sides; second pair of chin shields always in medial contact but never reach oral border; forelimbs with 3-3 toes in 37 specimens, 2-3 (1); preanal shields three in one, four (37); gulars six in 5 specimens, seven (33); longitudinal quadrangular ventral scale rows are 4-6 ($\bar{x}$ 5.4); see Table 3 for statistical analyses of other body scales.

Coloration.—Dorsal head surface similar to *B. barbouri,* except frontonasal scale usually densely spotted with brown; body and tail coloration like *barbouri* but dark lines usually straight, continuous and with dense freckling along each side.

Remarks.—The relationship of *peruana* to *dorbignyi* is discussed in the remarks section of *dorbignyi. Bachia peruana* shows a marked frontonasal reduction (occasionally lost) in the southern part of its range, allowing the nasal scales medial contact behind the rostral. When the frontonasal is lost, *peruana* superficially resembles *trisanale,* a species in which the frontonasal is always absent. However, a significant difference of 3 SE in numbers of dorsals and ventrals separates the two species.

Richard Thomas (pers. com.) found this species under rotting logs and in loose soil beneath decaying vegetation in coffee groves.

Bachia trisanale (Cope)
New Combination
Figure 8

Ophiognomon trisanale Cope, 1868:100 [Holotype.—ANSP 9637 from Napo or Alto Marañón, "Ecuador"; Mr. J. Orton collector].

Chalcides abendrothi Peters, 1871:399 [Syntypes.—ZMB (10 without numbers) from Sarayacu, Provincia Napo, Ecuador; collector unknown]. New synonymy.

Propus vermiformis Cope, 1874:70 [Holotype.—ANSP 11353 from Nauta, Perú; Mr. J. Orton collector]. New synonymy.

Ophiognomon abendrothi—Boulenger, 1885: 421.

Ophiognomon vermiforme—Boulenger, 1885: 421.

Range.—This species is widely distributed in the lowlands of eastern Ecuador and Perú, and probably occurs in southern Colombia and western Brasil (Fig. 9). Literature records from Cononaco (Peracca, 1897) and Igarape Champuia (Vanzolini, 1961c), Perú, are referable to *B. trisanale.*

Content.—Three subspecies.

Key to subspecies.—

1. Three toes on forelimb, hind limb tubercular 2
   One toe on forelimb, hind limb absent ..... *t. vermiformis*
2. Second pair of chin shields in medial contact ..... *t. abendrothi*
   Second pair of chin shields not in medial contact ..... *t. trisanale*

Diagnosis.—Dorsal and lateral body scales hexagonal, smooth and imbricate; ventral scales quadrangular, juxtaposed; tail scales similar to dorsals; nasal scales in broad contact behind rostral; frontonasal, prefrontals, interparietal and supraoculars absent; nasals, frontal and parietals present; forelimb toes one to three; hind limb tubercular or absent; superciliaries one to two on each side;

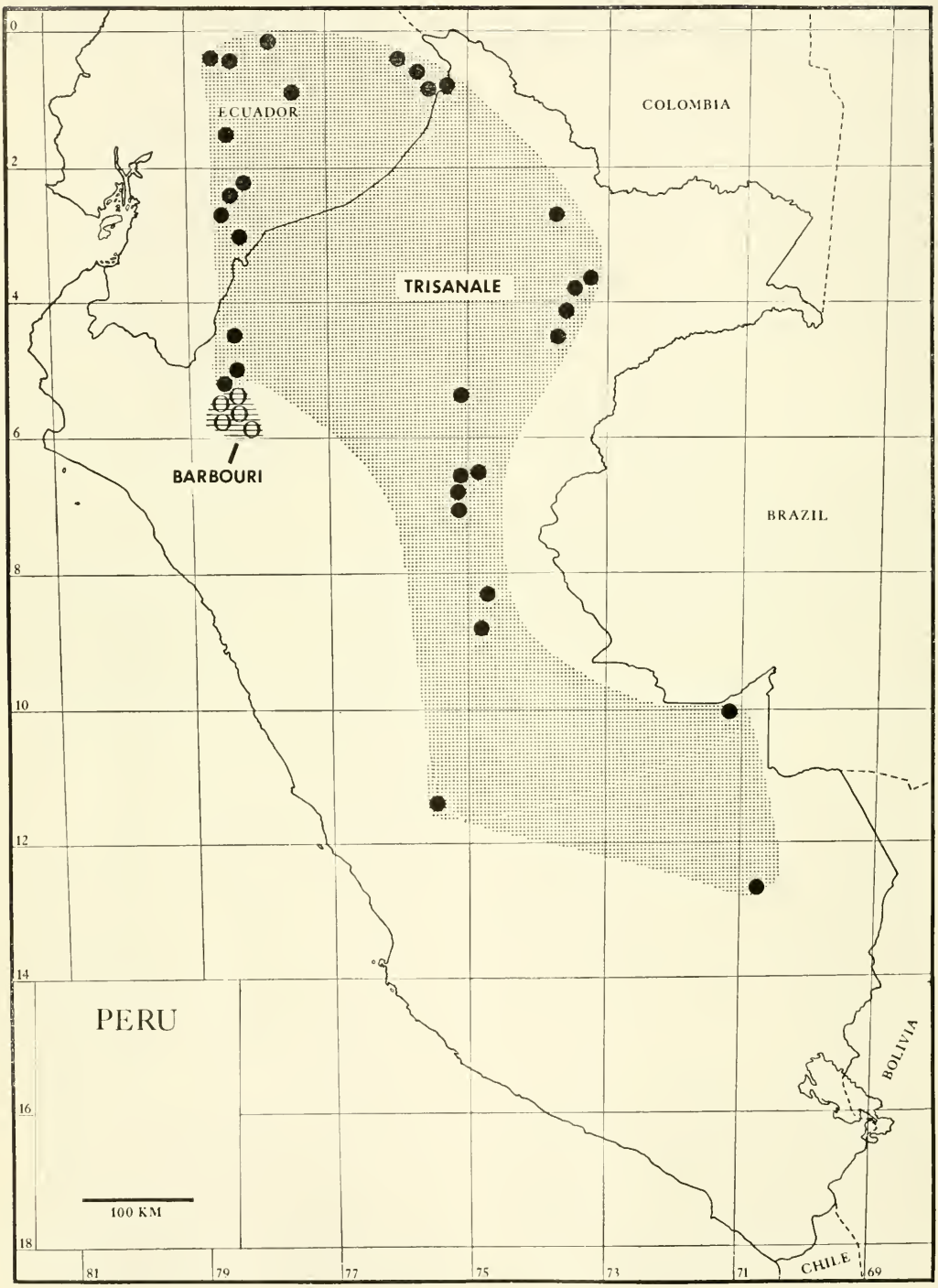

FIGURE 9. Distribution of *B. barbouri* and *B. trisanale* in Perú and Ecuador.

preanal pores 2-2 in males, 1-1 or absent in females; SAB 23-30 ($\bar{x}$ 26.2); dorsals 47-55 ($\bar{x}$ 50.6); ventrals 34-42 ($\bar{x}$ 37.7); preanal shields 3-5 ($\bar{x}$ 3.2); gulars 7-8 ($\bar{x}$ 7.1); maximum snout-vent length 79 mm.

Variation.—Two of 72 specimens lacked contact between fourth supraocular and parietal, four specimens had contact only on one side. The frontonasal, prefrontals, interparietal and supraoculars are absent in all specimens. Gular rows vary slightly with eight rows occurring 3 times, seven (69); longitudinal quadrangular ventral rows are 4-7 ($\bar{x}$ 5.8); preanal shields three in 69 specimens, four (6), or five (5).

Coloration.—Dorsal head surface uniform slate brown, blackish brown, or black, with or without pair of yellowish tan lines from above eye to posterior edge of parietals; light lines may be present as series of spots, dashes, or irregular blotches; lateral and dorsal head surfaces often obscurely mottled with brown and blackish brown; chin and throat similar to head color.

Dorsum of body and tail similar to *bicolor*, usually lacking a definite median dark line; area between paravertebral dark lines heavily freckled or mottled with dark brown to black; median dark line, when present, usually terminates above hind limbs; the two paravertebral dark lines extend to tail tip, upper side of body black, fading to blackish brown ventrally; venter dark brown, slightly lighter in color than sides of body.

Remarks.—*Bachia abendrothi* was originally described as having a smaller hind limb (tubercular) and more transverse body scale rows than *trisanale* (Peters, 1871). However, examination of 72 specimens from throughout the range of both species indicates complete overlap in the number of dorsals.

Hind limb length in populations originally assigned to *trisanale* from Ecuador and northern Perú, is 33-60 ($\bar{x}$ 45.0) percent of the preanal shield length, while those populations assigned to *abendrothi* from central and southern Perú have a hind limb length of 5-53 ($\bar{x}$ 34.2) percent of the preanal shield length. The numbers of dorsal and ventral scales respectively, vary from 47-55 ($\bar{x}$ 50.3), 34-42 ($\bar{x}$ 37.3) for the northern populations, while these characters for the central and southern populations are 48-55 ($\bar{x}$ 51.1), 34-42 ($\bar{x}$ 38.2). Numbers of SAB are similar, 23-30 ($\bar{x}$ 27.1) to the north, 23-30 ($\bar{x}$ 26.2) in the south.

The only useful character that separates the two populations is the presence or absence of medial contact between the second pair of chin shields. Only one specimen of 21 examined from south of 7° S lacks medial contact, and only one of 50 from north of 7° S has medial contact. Thus, I recognize *abendrothi* as a subspecies of *trisanale* by having the second pair of chin shields in medial contact.

Vanzolini (1961c) pointed out the similarities between the two species and suggested several hypotheses as to their relationships. He concluded that the two species should be recognized pending further investigations of geographic variation. Vanzolini noted that the type of *trisanale* could not be found and that Cope's (1868) count of the midbody scale rows (20) may be in error. There are 23 midbody scale rows rather than 20.

Since the original description of *vermiformis* by Cope (1874), no additional specimens representing the taxon have been found. However, in a series of 13 specimens of *trisanale* from the vicinity of Iquitos, Perú, several specimens show a marked reduction in the number of toes on the forelimb. The toes vary from 3-3 to 2-1 and the hind limb is represented by a small tubercle. The variation in the number of forelimb toes and the near absence of the hind limb suggests that the Iquitos population may represent intergrades between *trisanale* and *vermiformis*. Similar variation is present in populations of *monodactylus* from Surinam. Of the 13 specimens, eight have forelimb toes numbering 3-3, one 3-2½, two 3-2, one 2-2, and one 2-1.

The type locality of *vermiformis*, Nauta, Perú, is 95 airline kilometers SSW Iquitos. I would expect to find *vermiformis* sympatric with *trisanale* throughout this short distance of uniform habitat if *vermiformis* truly represented a distinct species. However, the squamation and color pattern of the type of *vermiformis* falls within the range of variation of *trisanale*, except for the medial contact of the second pair of chin shields. One specimen from Iquitos has the second pair of chin shields in medial contact, further suggesting that these two species are conspecific, therefore I regard *vermiformis* as a subspecies of *trisanale*.

Data taken from field tags indicate that most specimens of this species were found beneath decaying logs in primary or secondary forests along streams flowing into the Amazon Basin. Richard Thomas (pers. com.) found this species in loose soil around rotting palm trunks and beneath a board within a residential area of Yarinacocha, Perú.

The *Bachia heteropa* Group

The *Bachia heteropa* group comprises populations from Panamá, Colombia, West Indies, and Venezuela having 6 to 12 rows of hexagonal dorsal scales; 13 to 21 rows of quadrangular lateral and ventral scales; 4 digits on the forelimbs; interparietal and frontonasal shields present; prefrontal shields present or absent.

The complex is composed of two species, *pallidiceps* and *heteropa*, the latter with a rassenkreis of populations formerly recognized as six species *(heteropa, alleni, trinitatis, lineata, marcelae, anomala). Bachia alleni* and *B. trinitatis* were considered conspecific and *B. a. parviceps* relegated to the synonymy of *B. a. alleni* by Thomas (1965a). *Bachia lineata* and *B. marcelae* were considered conspecific by Donoso-Barros (1968) and *B. anomala* relegated to the synonymy of *lineata* by Burt and Burt (1933). Shreve (1947) suggested that *lineata* and *anomala* might not be conspecific.

I examined the holotype of *B. blairi* and found no differences between it and populations of *B. pallidiceps* of Panamá and Colombia. Hence I refer *blairi* to the synonymy of *pallidiceps*. The status of *B. cuvieri* was previously discussed; it may belong to this group. In addition, I find that certain head shield and digital characters that were formerly used to separate species of this group (i.e., *heteropa, lineata, alleni*) show an intermediate condition or, are of questionable value at the species level (*i.e.*, presence or absence of prefrontals, loss of toes on hind limb).

Thomas (1965a) indicated that *B. a. trinitatis* might represent an intermediate population between a mainland race related to *alleni* (= *heteropa*) and the population of *alleni alleni (=h. alleni)* on Grenada Island. He based this assumption on the separation of the prefrontals (split by contact of the frontonasal and frontal shields). All specimens from Grenada have prefrontals in medial contact, 15.4 percent of the Trinidad sample have medial contact and the mainland sample lacks medial contact. Populations of *Bachia* nearest the Río Orinoco delta tend to have prefrontals more reduced in size and more lateral in position. Populations of *Bachia* immediately west of the Paria Peninsula, Venezuela, have the prefrontals either fused to the anterior supraocular, or reduced to small azygous scales wedged between the nasal and anterior supraocular scales. In the western part of the range of *B. heteropa*, the number of supraoculars are smaller and reduced to two, and the prefrontals are fused to the loreal scale. Correlated with this shift in head scales, the frontonasal and frontal shields are enlarged and occupy the prefrontal space. The longitudinal rows of body scales are reduced in number (scales are larger), and the hind limbs are smaller with a corresponding reduction in the number of digits. The hind limb is moderately developed in *B. h. alleni* with four digits, slightly reduced with smaller toes in *B. h. trinitatis*, further reduced in size with loss of toes (three present) in *heteropa*

heteropa, and eventually a degenerate hind limb with two toes in *h. lineata* and *h. marcelae* (Fig. 10). All populations seem to be conspecific with slight modification in some for a more fossorial existence. The oldest available name for the species is *heteropa* Lichtenstein (1856).

Populations of *Bachia* (represented by *pallidiceps*) in northern Colombia and Panamá have retained distinct prefrontal shields (not in contact medially), have the digits of hind limb reduced to three (four in one specimen), and superficially resemble *B. h. trinitatis* from the Paria Peninsula of Venezuela. However, the former population has lost the median black stripe of the dorsum, has a reduced number of scales around the middle of the body, and has a higher number of longitudinal dorsal and ventral scales.

The generalized head scale pattern (presence of prefrontals) in *pallidiceps* must have been retained during the spread of populations of *Bachia* in the Cenozoic. Populations associated with mesic conditions have retained a generalized condition (*i.e.*, well developed limbs and toes, presence of prefrontals) favoring supraterranean existence in forest leaf litter. Those populations (*heteropa, lineata, marcelae*) associated with the "rain shadow" or arid scrub forests of northern Venezuela have become more adapted to a fossorial existence (*i.e.*, reduction in size of hind limb, loss of toes, loss of head shields).

Bachia heteropa (Lichtenstein)

Figure 11

Chalcides heteropus Lichtenstein, 1956:17 [Holotype.—SMF 39900 from La Guaira, Venezuela; collector unknown].

Bachia lineata Boulenger, 1903:432 [Holotype. —BMNH 1962.7.29.90 from Duaca, Estado

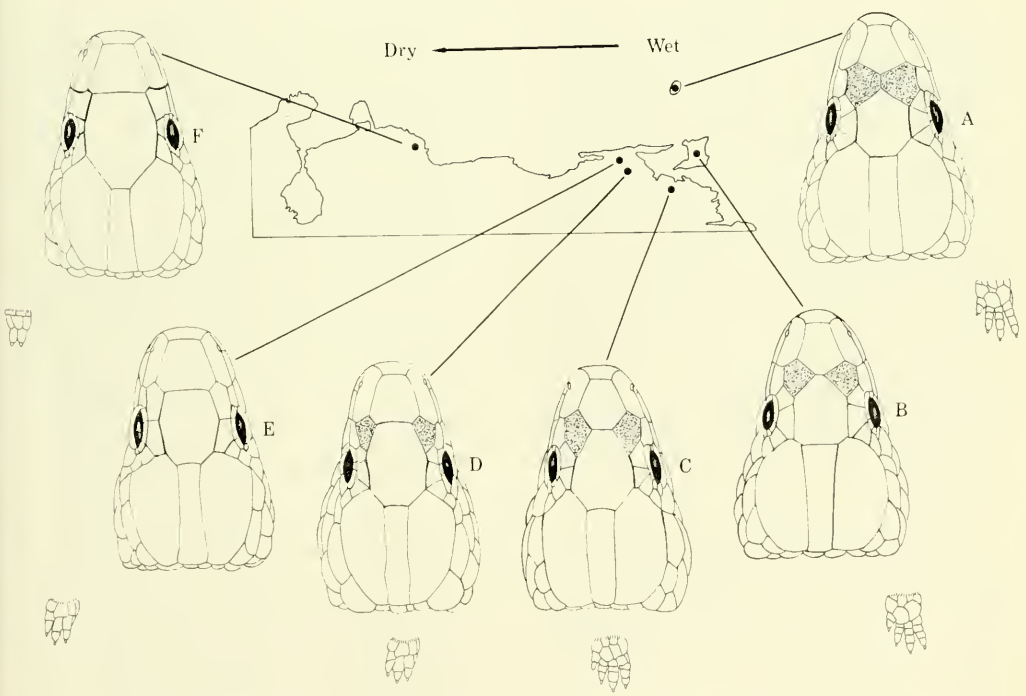

FIGURE 10. Progressive reduction in size and loss of prefrontal scales and hind limb toes in the *Bachia Heteropa* group in northern Venezuela. A. *B. heteropa alleni.* B. and C. *B. heteropa trinitatis* (Trinidad and mainland). D. *B. heteropa heteropa* x *heteropa trinitatis.* E. *B. heteropa heteropa.* F. *B. heteropa lineata.* Direction of arrow indicates trend from mesic to xeric habitat.

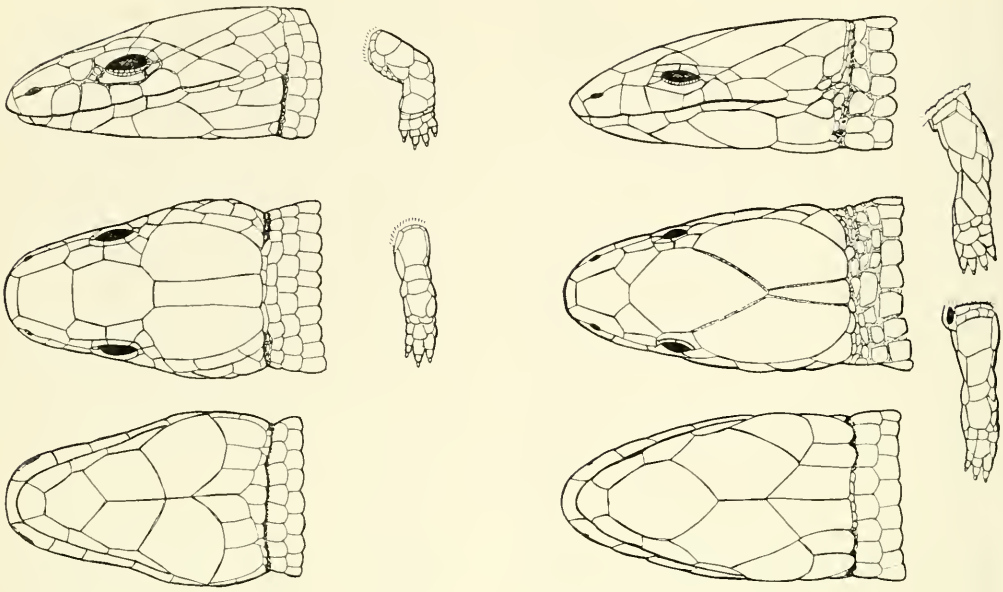

FIGURE 11. Lateral, dorsal, and ventral views of the head, dorsal view of the limbs of *B. heteropa* and *B. pallidiceps*.

Falcón, Venezuela; Mr. Wayman collector]. New synonymy.

Scolecosaurus alleni Barbour, 1914:315 [Holotype.—MCZ 7793 from St. George's, Grenada; G. M. Allen collector]. New synonymy.

Scolecosaurus trinitatis Barbour, 1914:316 [Holotype.—MCZ 8947 from Caparo, Trinidad; A. B. Carr collector]. New synonymy.

Bachia heteropa—Ruthven, 1925:105.

Bachia anomala Roux, 1929:31 [Holotype.—MB 9912 from El Mené, Distrito Acosta, Estado Falcón, Venezuela; H. G. Kugler collector]. New synonymy.

Bachia marcelae Donoso-Barros and Garrido, 1964:3 [Holotype.—D-B 6312061 from Bosque La Luz, Estado Barinas, Venezuela; R. Donoso-Barros collector]. New synonymy.

Range.—The islands of Grenada, Grenadines, Tobago, Trinidad, and the arid coastal zone of northern Venezuela, from El Mené east to Paria Peninsula, and south to the subtropical interior near La Luz (Fig. 12).

Literature records from the Port of Spain, Trinidad (Burt and Burt, 1931), 7.5 mi N San Juan, Caura Valley, Princeston-Moruga Road, Manzanilla Bay, Trinidad (Thomas, 1965a); Monagas, Venezuela (Thomas, 1965a); are referable to *Bachia h. trinitatis.* Those from Grenada, Grand Etang (Burt and Burt, 1931), 0.2 mi E Willis, 1 mi. SE Vincennes, 1 mi. N Vincennes, Bailey Bacolet Stock Farm, North Shore of Westerhall Bay, 0.8 mi S Sauteurs, Mt. Alexander (Thomas, 1965a); Grenadines; Cannovan Island (Thomas, 1965a); Tobago; 4 mi NE Penbroke, 4 mi N Mt. St. George (Thomas, 1965a), are referable to *Bachia h. alleni;* from La Luz, Barinas, Venezuela (Donoso-Barros and Garrido, 1964) to *Bachia h. marcelae.*

Content.—Five subspecies.

Key to Subspecies.—If prefrontals appear to be present but quite lateral in position, the specimen may be an intergrade between *h. trinitatis* and *h. heteropa.* Check the number of toes on the hind limb for correct allocation.

1. Prefrontals present, four toes on hind limb 2

   Prefrontals absent, three or less toes on hind limb 3

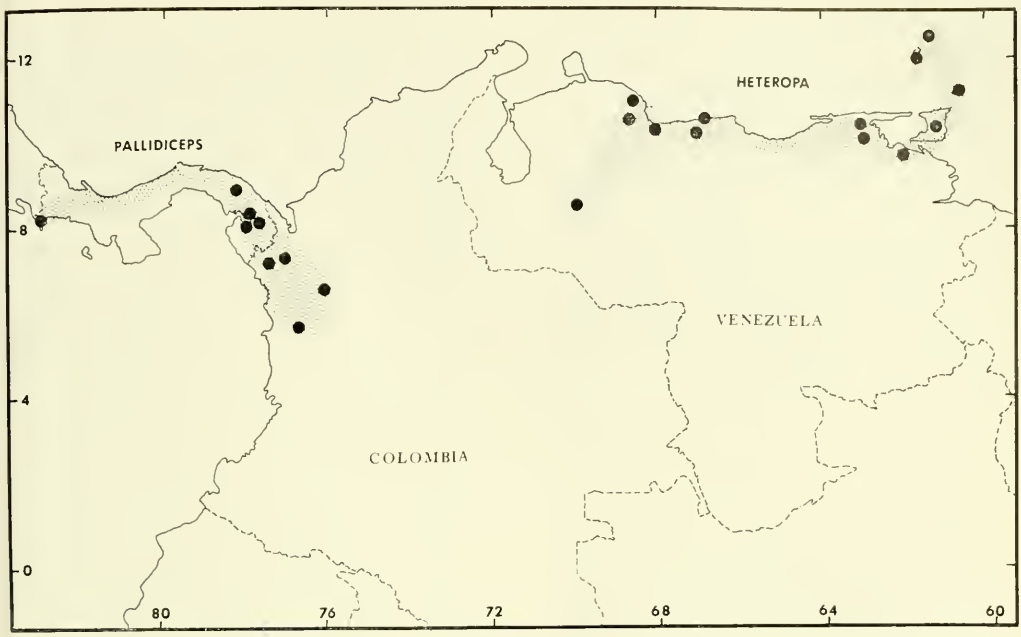

FIGURE 12. Distribution of *B. heteropa* and *B. palliidiceps* in northeastern South America and Panamá.

2. Prefrontals not in medial contact ..... *heteropa trinitatis*
   Prefrontals in medial contact ..... *heteropa alleni*
3. Hind limb with two distinct toes ... 4
   Hind limb with three distinct toes ..... *heteropa heteropa*
4. Seven rows of scales in front of pectoral shields ..... *heteropa lineata*
   Five rows of scales in front of pectoral shields ..... *heteropa marcelae*

Diagnosis.—Five to 12 longitudinal rows of hexagonal, smooth and imbricate dorsal body scales; 16 to 22 longitudinal rows of quadrangular, juxtaposed lateral and ventral scales; tail squamation similar to body scales in subspecies *heteropa, lineata* and *marcelae,* mostly hexagonal in *alleni* and *trinitatis;* interparietal, frontonasal, nasals and parietals present; two or three supraoculars and superciliaries; second pair of chin shields not usually in medial contact nor reaching oral border; no labial/parietal contact; four toes on forelimbs; two to four toes on hind limbs; males with one to two preanal pores, absent in females; SAB 24-31 ($\bar{x}$ 28.4); dorsals 38-49 ($\bar{x}$ 41.6); ventrals 24-36 ($\bar{x}$ 27.0); gulars 7-8 ($\bar{x}$ 7.5); maximum snout-vent length 64 mm.

Variation.—The general variation of this species was discussed in the introduction to the group. I have not found intermediate specimens between *lineata* and *heteropa,* though I expect them to occur between Caracas and the Paria Peninsula. The reduction from three to two toes may or may not be controlled by a single dominant gene; however, this type of reduction is widespread in *B. monodactylus,* with many specimens showing various combination of toes on the hind limbs. The progressive loss of the prefrontal shields is illustrated in figure 10. A reduced number of gular scale rows follows the general evolutionary trend outlined in the introduction to the group. The number of gular rows are eight in all *h. alleni,* reduced to seven in 57.5 percent on *h. trinitatis,* seven in all *h. heteropa* and *h. lineata,* and five in *h. marcelae.*

The number of preanal shields is usually four in all subspecies of *heteropa*, with three and five occurring once in 80 specimens. The number of SAB varies slightly between subspecies with *alleni* having 27-31 ($\bar{x}$ 29.0), *trinitatis* 26-31 ($\bar{x}$ 28.5), *heteropa* 28-30 ($\bar{x}$ 29.3), *lineata* 24-26 ($\bar{x}$ 25.3), *marcelae* 25 (3 specimens). Number of dorsal scale rows are: *alleni* 39-45 ($\bar{x}$ 40.9), *trinitatis* 38-45 ($\bar{x}$ 41.3), *heteropa* 45-47 ($\bar{x}$ 45.3), *lineata* 45-49 ($\bar{x}$ 47.2), *marcelae* 39-42 ($\bar{x}$ 40.7). Number of ventrals: *alleni* 24-29 ($\bar{x}$ 26.4), *heteropa* 27-30 ($\bar{x}$ 28.3), *lineata* 24-26 ($\bar{x}$ 25.3), (not known for *marcelae*). The number of supralabials and infralabials is usually 6/6 or 6/5 for all subspecies. The number of supraoculars is always three in *alleni* and *trinitatis*, usually two in *heteropa* but occasionally three in intergrades between *heteropa* and *trinitatis*, and always two in *lineata* and *marcelae*. The number of supercilaries is always three in all subspecies except 3/4 occurring once in 80 specimens.

One specimen is intermediate between *heteropa* and *trinitatis;* it has the second pair of chin shields in medial contact, a unique condition in *B. heteropa*. The medial contact may be due to recombination of genes between intergrading populations, or some genetic influence from an unknown population of *Bachia* in the area. The problem will be resolved only by additional sampling in the area of contact between the two populations.

Coloration.—Each subspecies tends to vary slightly from the basic body pattern of three longitudinal dorsal dark lines alternating with four wider, light interspace stripes, extending from the parietals onto the tail. The sides of the body are dark brown to blackish and the venter light brown to yellowish tan in all subspecies. *Bachia h. alleni* tends to have the median dark line obscure, with the paravertebral dark lines broken into a series of dashes or spots and the light interspaces heavily mottled or freckled with dark brown. *Bachia h. trinitatis* has retained the three dark lines, although occasionally broken or irregular. The two paravertebral light interspace stripes are usually freckled with dark brown, whereas the two dorsolateral light interspace stripes are uniform tan to yellowish brown. The three dorsal dark lines are usually evident in the remaining subspecies, occasionally irregular, with the light interspace stripes less freckled or mottled. All subspecies tend to have the upper edge of the lateral dark stripe darker than the stripe, giving an illusion of five dark stripes on the body.

Remarks.—Barbour (1914) indicated that *B. h. alleni* is a burrower, but did not say that he actually found specimens in burrows. He stated that the type series of *B. h. trinitatis* came from beneath fallen cacao pods. Parker (1935b) stated that a stomach of *trinitatis* contained a small earwig, a dipterous larva, and a mass of mycetophilid larvae.

The size and development of the limbs and toes suggests that *B. h. lineata* and *marcelae* are predominately fossorial, *heteropa* partially fossorial, and *alleni* and *trinitatis* supraterranean leaf litter inhabitants.

Bachia pallidiceps (Cope)

Figure 11

Brachypus pallidiceps Cope, 1862:356 [Holotype.—ANSP 4324 (lost) from Río Truando Region, Colombia; L. Michler collector].

Scolecosaurus blairi Dunn, 1940:115 [Holotype.—ANSP 21773 from Puerto Armuelles, Chiriquí, Panamá; E. R. Dunn collector]. New synonymy.

Bachia pallidiceps—Vanzolini, 1961b:204.

Range.—Northwestern Panamá to west-central Colombia (Fig. 12). A literature record for Laguna de Pita, Panamá (Dunn, 1940) is referable to this species.

Diagnosis.—Dorsum of body with 7-14 longitudinal rows of hexagonal, smooth imbricate scales; lateral and ventral body surfaces with 10-16 rows of quadrangular, juxtaposed scales; tail and body scales similar; nasals, frontonasal, parietals, interparietal, prefrontals pres-

ent; prefrontals not in medial contact; two supraoculars and superciliaries; second pair of chin shields not in medial contact nor reaching oral border; no supralabial/parietal contact; four clawed toes on forelimbs; hind limbs with three toes (four in one specimen); preanal shields four; preanal pores 1-1 in males, absent in females; SAB 21-25 ($\bar{x}$ 22.9); dorsals 43-48 ($\bar{x}$ 45.3); ventrals 30-34 ($\bar{x}$ 31.6); gulars 7; maximum snout-vent length 73 mm.

Variation.—Little variation was noted in this species, other than body squamation (see table 3 for statistical analyses).

Coloration.—The dorsal color pattern varies from almost uniform dark brown to black ground color without lateral stripes (*blairi* Dunn 1940), to a dark brown or black median stripe about four scale rows wide, bordered by a golden tan to yellowish line one to two scale rows wide. The dorsolateral light stripe (line) begins at the nape and continues onto the tail, fading into a series of broken lines from proximal half of tail to near the tip. The venter is black or dark brown, throat and chin dark gray. The head is black or dark brown above, with or without faint light brown spots on the parietals.

Remarks.—Dunn (1940) stated that his specimen of *blairi* (= *pallidiceps*) was taken beneath debris along the bank of a small stream. No other natural history information is available.

Bachia pallidiceps resembles *B. h. trinitatis* in the position of the prefrontal and occasional presence of four toes on the hind limb, but it differs by having fewer SAB, supraoculars, and superciliaries, and more dorsals and ventrals. In addition, *pallidiceps* lacks freckled light stripes and has a black to dark brown venter.

Thomas (1965b) stated that Boulenger (1887) may have been correct in regarding *pallidiceps* as a synonym of *heteropa,* and suggested a racial relationship based upon prefrontal contact. However, Thomas (1965b) had not seen specimens of *heteropa,* but instead, based his conclusions on Boulenger's (1887) redescription of the type. Beebe's (1945) illustration of *heteropa* referred to by Thomas (1965b) is actually an intergrade between *heteropa* and *trinitatis,* and possesses three supraoculars in addition to prefrontals. Regarding supraoculars, Thomas (1965b) correctly inferred specific differences between *pallidiceps* (two supraoculars) and *heteropa* (three supraoculars). However, by recognizing *lineata* and *marcelae* as subspecies of *heteropa, pallidiceps* could be recognized as a race of *heteropa,* disregarding other characters that support specific recognition.

The *Bachia flavescens* Group

The *Bachia flavescens* group is comprised of two species *(flavescens, monodactylus),* each with two races, and possibly a third undescribed species from Colombia. The group occupies the Guiana Shield and certain areas in the lower and middle Amazon Basin in Brasil and Colombia.

The group includes those populations having quadrangular, juxtaposed scales covering the entire body and tail; prefrontal shields absent; interparietal present or absent; one or two supraoculars; two or three superciliaries; two to three digits on the forelimb; one to three digits on the hind limb, or only a minute tubercle present.

I mentioned the confusion concerning the names *flavescens, cophias,* and *tridactyla* in the introduction to this paper. Until Peters and Donoso-Barros' (1970) investigation of the status of the names, all were used for about 100 years. Brongersma (1946) distinguished between *tridactyla* and *schlegeli* (Duméril and Bibron) and retrieved *schlegeli* from Boulenger's (1885) synonymy of *tridactyla;* Brongersma (1946) also showed that Boulenger's (1887) description of *boettgeri* was identical to that of *schlegeli.* Vanzolini (1950) discovered that the name *tridactyla* (Daudin) was preoccupied by *Chalcides tridactyla* (a

skink) and consequently substituted the earliest available name, *schlegeli* (Duméril & Bibron, 1839). However, Vanzolini had not seen Brongersma's (1946) paper and later (Vanzolini, 1961) suggested some other name be used but did not specify which one. Burt and Burt (1931) showed that *flavescens* (Bonnaterre, 1789) was the oldest described form of *Bachia,* and that Boulenger (1885) had applied the name of those populations with a single toe on the hind foot. Because *flavescens* was described as having three toes on the hind foot, Burt and Burt (1931) suggested that Daudin's (1802) description of *tridactyla* was identical with *flavescens.* They indicated that the name *cophias* (Schneider, 1801) was applicable to those populations having one toe on the hind foot. Thus, Schneider's species, *cophias,* became established for those populations of *Bachia* having quadrangular body scales and one toe on the hind limb. The latter name was in common usage until Peters and Donoso-Barros (1970) pointed out that the descriptions of *cophias, flavescens,* and *tridactyla* were based upon Lacepede's (1789) iconotype, and that *flavescens* was the earliest available name for the populations with three toes and quadrangular scales, and that *monodactylus* (Daudin, 1802) should be used for the populations with single toes.

I find only minor differences between *Bachia flavescens* and *B. schlegeli.* I have examined the holotype of *schlegeli,* one additional specimen from the British Museum, and the only known specimen of *flavescens* (UMMZ 65170). The only difference between *flavescens* and *schlegeli* is the number of toes on the hind limb (*schlegeli* has two, *flavescens,* three). I regard the latter characters as suspect, because the number of toes on the hind foot is highly variable within and between populations of this group. A similar situation exists between *monodactylus* and *parkeri,* and the only character of value is the presence of one supraocular in *parkeri,* two in *monodactylus.* The presence or absence and variation in number of supraoculars in other species of *Bachia* indicates that this character is probably not reliable at the species level. I consider *schlegeli* as a subspecies of *flavescens,* and *parkeri* a subspecies of *monodactylus.*

Bachia flavescens (Bonnaterre)

Figure 13

Chalcides flavescens Bonnaterre, 1789:67 [Holotype.—unknown; type locality and collector unknown].

Chalcides cophias Schneider, 1801:209 [Holotype.—unknown; type locality and collector unknown].

Chamaesaura tridactylus Daudin, 1802:367

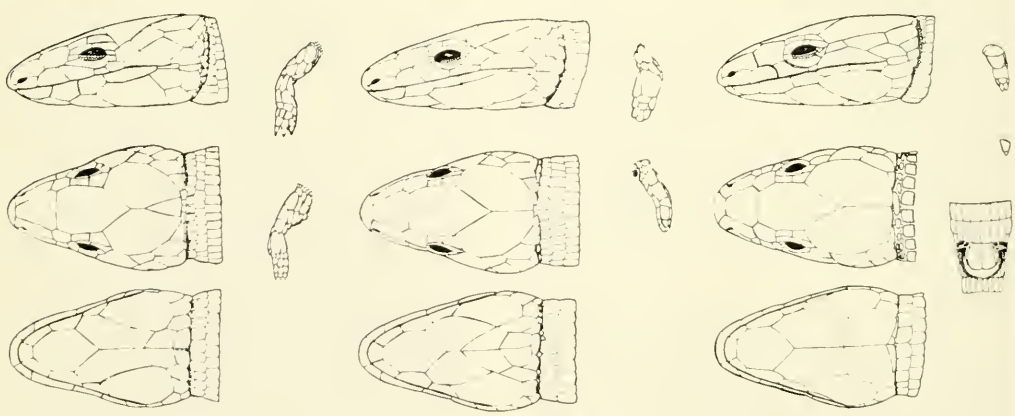

FIGURE 13. Lateral, dorsal, and ventral views of the head, dorsal view of the limbs of *B. flavescens, B. monodactylus* and *Bachia sp.*

[Holotype.—unknown; type locality and collector unknown].

Chalcides schlegeli Duméril and Bibron, 1839: 457 [Holotype.—RMNH 3580 from "Calcutta" (in error); collector unknown]. New synonymy.

Cophias boettgeri Boulenger, 1887:517 [Holotype.—SMF 39900 from Central America?, collector unknown]. New synonymy.

Bachia flavescens—Burt and Burt, 1931:317.

Range.—Known only from Kartabo and Moraballi, Guyana (Fig. 14). The British Museum has one additional specimen (1903.5.29.2) from Ireng Valley, Guyana, that I have not seen.

Content.—Two subspecies.

Key to subspecies.—

1. Three toes on the hind foot ..... *flavescens*

Two toes on the hind foot ..... *schlegeli*

Diagnosis.—Body and tail with quadrangular, juxtaposed scales; nasals, parietals, interparietal, frontonasal and frontal present; two supraoculars; three superciliaries; three toes on forelimb, two to three toes on hind limb, all toes clawed; males with two preanal pores on each side, absent in females; SAB 30-32 ($\bar{x}$ 31.0); dorsals 46-48 ($\bar{x}$ 47.3); ventrals 33-34 ($\bar{x}$ 33.3); gulars 7; preanal shields 3 or 4; maximum snout-vent length 67 mm.

Variation.—There is more variation in the shape and size of the interparietal of this species than one might expect from an examination of only four specimens, and only two of these from definite localities. In two specimens the interparietal splits the parietals and contacts the frontal. In one, the interparietal is about 75 percent of the parietal length, allowing contact of the parietals at their medial anterior ends. One specimen has a smaller interparietal, about 60 percent of the parietal length and allowing greater contact of the parietals at their medial anterior ends.

The reduction in interparietal size suggests that loss of the scale may occur in some individuals. Other than the interparietal, the only important variation is reduction from three to two toes on the hind limb. The only specimen of *f. flavescens* examined has three toes on the hind limbs and was taken on the west side of the Río Essequibo, Guyana, while all specimens of *f. schlegeli* have two

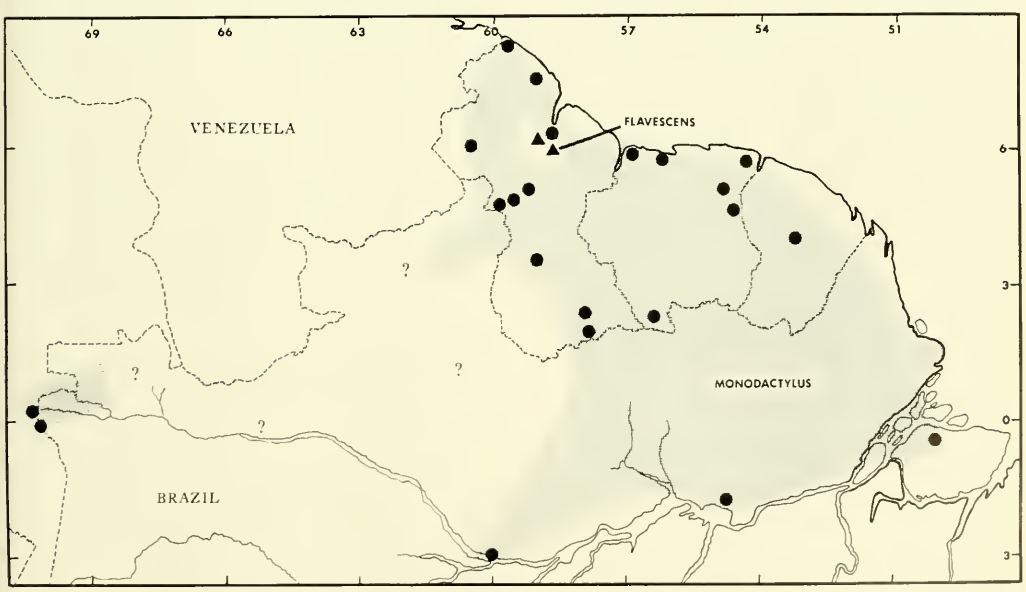

FIGURE 14. Distribution of *B. flavescens*, *B. monodactylus* and *Bachia sp.* in northeastern South America.

toes on the hind limb and occur on the east side of the Río Essequibo. Although only 24 km separates the two localities, the river may act as an effective barrier, preventing unrestricted gene flow between the two subspecies.

Coloration.—Both subspecies of *flavescens* have a dorsal coloration consisting of three obscure dark brown lines (one median, two dorsolateral), with irregular edges. Occasionally, the dorsum is heavily pigmented with dark brown and the lines are no longer discernible, and the yellowish-brown interspaces reduced to two linear rows of small obscure spots. The head is usually brown to blackish-brown, without invasion of yellowish-brown ground color. The tail may or may not have the dorsal dark lines extending onto it. The sides are dark brown to black and grade abruptly into the yellowish-tan venter.

Remarks.—The presence of three superciliaries in *B. flavescens* would be the only character separating it from *monodactylus* if some populations of *flavescens* lost the interparietal. Some individuals of *monodactylus* have two toes on the hind foot, one specimen having two toes on one limb and three on the other. There is complete overlap in the range of body squamation between species. As additional material becomes available, the variation exhibited may show intermediacy between the two species and thus suggest that they are conspecific. However, both species have been taken from vicinity of Kartabo, Guyana, and show no intermediacy at that locality.

Bachia monodactylus (Daudin)

Figure 13

Chalcides monodactylus Daudin, 1802:370 [Holotype.—lost, type locality and collector unknown].

Colobus daudini Merrem, 1820:76 [Replacement name for *Chalcides monodactylus* Daudin].

Chalcides trilineatus Peters, 1872:775 [Holotype.—ZMB no number (lost) from South America; collector unknown].

Bachia parkeri Ruthven, 1925:103 [Holotype.—UMMZ 60813 from Chenapowu River "on the upper Potaro River," Guyana; collector unknown]. New synonymy.

Bachia monodactylus—Peters and Donoso-Barros, 1970:81.

Range.—Colombia to Cayenne and south to Manáus, Brasil, South America (Fig. 14). Literature records for Moreira, Brasil (Cunha, 1958), Kartabo, Guyana (Beebe, 1945), and Ananas Mountain, Surinam (Brongersma, 1946) are referable to *Bachia m. monodactylus.*

Content.—Two subspecies.

Key to subspecies.—

1. Two supraoculars present ..... *m. monodactylus*

One supraocular present ..... *m. parkeri*

Diagnosis.—Body and tail with quadrangular, juxtaposed scales; interparietal absent; nasals, frontonasal, frontal, parietals present; one or two supraoculars; two superciliaries; second pair of chin shields without medial contact nor reaching oral border; no supralabial touching parietal; forelimb with three clawed toes; hind limb with single toe and limb somewhat degenerate, or hind limb with two definitive toes or combinations of one toe on one limb, two on the other; males with two preanal pores on each side, absent in females; SAB 26-33 ($\bar{x}$ 29.2); dorsals 46-55 ($\bar{x}$ 49.6); ventrals 33-39 ($\bar{x}$ 35.5); gulars 7-8 ($\bar{x}$ 7.1); preanal shields 3 or 4; maximum snout-vent length 80 mm.

Variation.—The number of toes on the hind foot of *B. monodactylus* is highly variable. The toes vary from an almost styloform terminal scale, to two distinct toes with an occasional third toe on one of the legs. Specimens from the central and eastern part of the species range (Surinam, Cayenne) may have one or two toes on each foot and occasionally one on one foot, two on the other. Samples from northern Guyana have a similar arrangement, whereas those from central and southern Guyana have a single terminal scale resembling a toe. Specimens from the vicinity of Manáos, Brasil, are similar to the latter except one specimen with two toes on each hind foot. By combining the number of toes

on each hind foot and dividing by two, the average number of toes per hind foot for specimens from Guyana are 1.41, Brasil 1.50, Surinam 1.62, and Cayenne 1.83.

The supralabials and infralabials are usually 5-5, but are occasionally 5-4 or 6-6. The preanal plate is normally composed of three scales (34 specimens) but occasionally varies to four (10) or five (2). SAB are 26-33 ($\bar{x}$ 29.2); dorsals 47-53 ($\bar{x}$ 49.6); ventrals 33-39 ($\bar{x}$ 35.5); number of gular scales normally seven (41 specimens), but occasionally eight (5).

There is no significant difference between the number of SAB, dorsals, ventrals, and gulars of populations of *B. monodactylus* from Guyana, Brasil, Surinam, and Cayenne. The means of SAB, dorsals and ventral scales respectively, are Guyana (28.4, 49.1, 35.2) Brasil (26.8, 49.0, 34.4) Surinam (30.9, 50.4, 36.6) Cayenne (29.7, 49.7, 35.4).

The only character separating the western populations of *monodactylus* in Colombia and extreme western Guyana from those farther east and south is the presence of a single supraocular in the former. All other squamation characters fall within the range of variation of the total population. The shift from two supraoculars to one is accomplished by the expansion of the frontal scale, creating a reduction in size and fusion of one of the supraoculars (usually the anterior one) with either the anterior superciliary or the frontal. This type of fusion has been observed in populations of *Bachia intermedia (dorbignyi* group).

Bachia monodactylus parkeri is known only from the type series and is presently allopatric from the nominate race by only 18 airline kilometers.

Coloration.—The color pattern of both subspecies consists of three distinct, dorsal dark brown to black lines extending from the collar fold onto the tail; the dark lines are separated by ground color stripes of yellowish-tan to light brown. The sides of the body are dark brown to almost black, with the upper edges frequently black, giving an allusion of five blackish stripes or lines on the upper surface of the body. Occasionally the paravertebral dark lines are broken into a zig-zag pattern with each indentation yellowish-tan; the light stripes are frequently freckled or heavily mottled with dark brown. The head is usually dark brown with two light stripes reaching anteriorly to the edge of the frontal. The venter is yellowish-tan to brown and may or may not grade into the dark sides.

Remarks.—Beebe (1945) stated that specimens of this species taken in Guyana during the dry season were found under logs, jungle debris, and as deep as 30 cm in the soil while workers were digging jungle pits. They were also taken from the nests of leaf-cutter ants (*Attas* sp.). During the rainy season *monodactylus* were found during early morning hours crawling over wet leaves. Specimens taken by M. S. Hoogmoed (pers. com.) in Surinam were found inside of decaying tree trunks, under logs and near openings in hills.

Beebe (1945) stated that stomachs of some *monodactylus* contained grubs, ants, sowbugs, and termites. He found one specimen of *B. monodactylus* in the stomach of a coatimundi.

Beebe (1945) also reported that one specimen laid an egg 4.1 X 11.5 mm beneath a leaf. The shell was leathery with slight longitudinal striae on the surface.

A single specimen of the *flavescens* group from Timbo, Colombia, (Fig. 14) cannot be allocated to any of the currently recognized populations of *B. monodactylus*. This male (MM R-3477, Fig. 13) having a snout-vent length 50 mm, resembles *monodactylus* by having two supraoculars and two superciliaries, but differs in several other features. The specimen represents the most fossorial member of the *flavescens* group. The hind limb is reduced to a small tubercle with one minute apical scale (Fig. 15). The forelimbs are short with two apical scales resembling toes. One preanal pore

on each side and preanal plate composed of two large scales. The SAB (23) is outside the range of *monodactylus* (26-33), whereas the dorsals (53) and ventrals (39) are the highest extremes for *monodactylus*.

This specimen may represent the extreme end of a cline from Manáos, Brasil, to the Río Vaupés, via the Rio Amazonas, Rio Negro, and Rio Vaupés. Supporting this hypothesis are specimens of *monodactylus* from Brasil having a degenerate hind limb with one toe and the lowest number of SAB (26) for the species. However, the distance separating Manáos and Timbo is an airline distance of 1300 kilometers, representing a formidable allopatric gap.

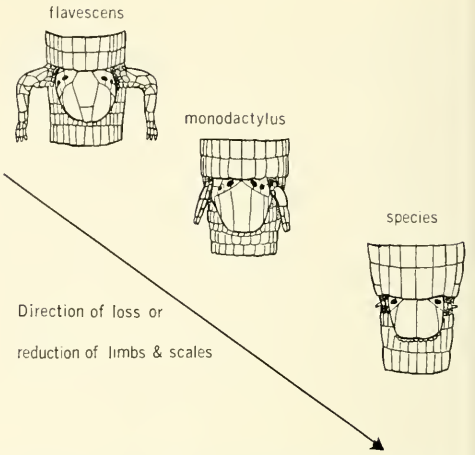

FIGURE 15. Ventral view of the pelvic region of members of the *Bachia flavescens* group showing progressive loss of body scales and hind limb reduction.

SUMMARY

Bachia is one of three genera in the family Teiidae lacking external ears; the other genera are *Anotosaura* and *Heterodactylus*. The fifteen species of *Bachia* exhibit differences in the type of body scales, other external structural features, coloration, and in certain features of osteology. Most species of *Bachia* are distributed in the semi-arid foothills and tropical lowlands surrounding the Amazon Basin, with some taxa occurring outside of the Basin on some of the Caribbean Islands, north of the Colombian Andes to Costa Rica, but not on the Pacific lowlands of South America. There are areas of sympatry between species of different species groups and only one instance of sympatry between species of the same group.

Evolutionary trends within the genus are related to fossorial adaptations within species and species groups. The characters that showed the greatest amount of specialization (*i.e.*, loss of limbs, toes, various combinations of head scales in sequence; modification of body scales for greater flexibility and of neck vertebrae for stronger vertical thrusts) were utilized in an analysis of inter- and intraspecific relationships. The basic evolutionary trend is toward fossorialism in each species group, and each group is independently evolving toward fossorial adaptations at different rates and by different combinations of character modifications.

The systematic statuses of the genera *Bachia*, *Ophiognomon*, *Anotosaura* and *Heterodactylus* are clarified for the first time. The possible origin of *Bachia* and a definition of the genus is presented. The variability in coloration, types of body scales, size and number of limbs and toes, and cephalic squamation, has resulted in thirty names being proposed for various species of the genus. Five nominal species are herein relegated to the synonymy of *Bachia heteropa* (Lichtenstein, 1856); these are *Bachia lineata* Boulenger, 1903, *Scolecosaurus alleni* Barbour, 1914, *Scolecosaurus trinitatis* Barbour, 1914, *Bachia anomala* Roux, 1929, *Bachia marcelae* Donoso-Barros and Garrido, 1964; to the synonymy of *Bachia trisanale* (Cope, 1868), *Hapalolepis abendrothii* Peters, 1871 and *Propus vermiformis* Cope, 1874; to the synonymy of *Bachia flavescens* (Bonnaterre, 1789), *Chalcides schlegeli* Duméril and Bibron, 1839; to the synonymy of *Bachia monodactylus* (Daudin, 1802), *Bachia parkeri* Ruthven, 1925.

RESUMEN

Bachia es uno de los tres géneros en la familia Teiidae que carecen de oido externo; los otros géneros son *Anotosaura* y *Heterodactylus*. Las quince especies de *Bachia* muestran diferencias en el tipo de escamas corporales, otras características externas, coloración, y en ciertas extructuras osteológicas. La mayoría de las especies de *Bachia* se distribuyen en el pie de monte semiárido y en las bajas elevaciones tropicales que rodean la cuenca amazónica, con algunas especies distribuidas en algunas de la islas del Caribe, norte de los Andes Colombianos hasta Costa Rica, pero no se encuentran en las bajas elevaciones de las costa del Pacífico en Sur América. Hay áreas simpátridas entre especies de diferentes grupos, y solo un caso de simpatria entre especies del mismo grupo.

Las tendencias evolutivas se descifraron por las adaptaciones intra- e interespecíficas y entre grupos de especies, a la vida subterránea. En el análisis de las relaciones intra- e interespecíficas se usaron aquellos caracteres que mostraron mayor especialización (pérdida de extremidades, artejos, varias combinaciones en las secuencias de las escamas cefálicas; modificación de las escamas corporales para mayor flexibilidad, y de las vértebras cervicales para excavar mejor). La tendencia evolutiva básica en cada grupo está evolucionando a diferentes niveles y mediante diferentes combinaciones de modificaciones de los caracteres hacia este tipo de adaptación.

Se clarifica por primera vez la posición sistemática de los géneros *Bachia, Ophiognomon, Anotosaura* y *Heterodactylus*. Se presenta el posible origen de *Bachia,* asi como una definición del género. Debido a la variación, en coloracíon, tipos de escamas corporales, tamaño y núemro de extremidades y artejos, escamas cefálicas, en el pasado se han propuesto treinta nombres para varias especies del género. Se relegan cinco especies nominales al sinónimo de *Bachia heteropa* (Lichtenstein, 1856); éstas son *Bachia lineata* Boulenger, 1903, *Scolecosaurus alleni* Barbour, 1914, *Scolecosaurus trinitatis* Barbour, 1914, *Bachia anomala* Roux, 1929, y *Bachia marcelae* Donoso-Barros y Garrido, 1964; al sinónimo de *Bachia trisanale* (Cope, 1868), *Hapalolepis abendrothii* Peters, 1871 y *Propus vermiformis* Cope, 1874; al sinónimo de *Bachia flavescens* (Bonnaterre, 1789), *Chalcides schlegeli* Duméril y Bibron, 1839; al sinónimo de *Bachia monodactylus* (Daudin, 1802), *Bachia parkeri* Ruthven, 1925.

SPECIMENS EXAMINED

The arrangement of the localities for each of the specimens examined is as follows: alphabetically by country, state (department or province), and locality; alphabetically by the first letter in the abbreviations for the museums, and numerically after each museum abbreviation. Specimens lacking precise locality data are listed last in the most restricted political unit possible. Where more than one specimen is included under one museum number, the number of specimens is given in parentheses after the museum number.

Bachia sp.

COLOMBIA: *Vaupés:* Timbo, near Mitú on Río Vaupés, MM R-3477.

Bachia barbouri

PERÚ: *Amazonas:* 19 km S Bagua, LACM 49333-39; 3 km S junction Bagua and Bagua Grande road, LACM 49347-50, TCWC 28899, 28905-08; 3.5 km SE Bagua Grande, LACM 49344-46, TCWC 28903-04; 8 km WSW Bagua Grande, MVZ 82444-45, 82449-50; 15.5 km W Bagua Grande, LACM 49340-43, TCWC 28900-02; 1.2 km NE Milagro, LSUMZ 19375-77; 5 km SW Milagro, LSUMZ 19378; 14 km NE Milagro, LSUMZ 19379; 5.2 N Rio Marãnón bridge, LACM 49351, TCWC 28909. *Cajamarca:* Bellavista, MCZ 14740-41, 14843-44, 14746, 14748-49, 14751, 14754-55, 14758, USNM 120788; 6 km N Bellavista, LSUMZ 19373-74; Perico, AMNH 28437, MCZ 32770.

Bachia bicolor

COLOMBIA: *Atlantico:* Barranquilla, BMNH 1961.1862-63; MCZ 58784; Ciénega

de Amajahuevo, FMNH 165776. *Bolivar:* Cartagena, BMNH 1928.1.5.1, FMNH 165774-75. *Cundinamarca:* Bogotá, AMNH 9544-45 (probably in error). *Magdalena:* Bolivar, UMMZ 54767; Loma Larga, UMMZ 54776 (3); Magdalena, MCZ 29325; Palomina, MCZ 6559; Finca El Aranar, Bonoa, FMNH 165777; Río Frío, MCZ 25053, 29715; 11 km W Santa Marta, CAS 116302; no specific locality MNHM 2842. *Norte de Santander:* Cucutá, USNM 84971. *Sur de Santander:* S of Bucaramanga, AMNH 91765; Bucaramanga, AMNH 92994-96.

Bachia bresslaui

BRASIL: *Mato Grosso:* Utiariti, Rio Papagaio, MZUSP 10300.

Bachia dorbignyi

BOLIVIA: *Santa Cruz: El Beni:* Esperanza, BMNH 1920.11.29.10; Rio Sirutu UMMZ 63782; Tumupasa, AMNH 22525; no specific locality BMNH 1904.10.29.17. *La Paz:* Barranca, on Río Madidi, BMNH 98.6.9.9; Buenavista, BMNH 1927.8.1.168-170, UMMZ 60513 (2), 60515 (3), 60520 (2), 60587 (5), 60589 (4), 60590 (2), 63083, 63781 (9), 68082 (3), 68083 (2), 68084-85, 68086 (2) USNM 94095, FMNH 35588-89; Santa Cruz MNHN 2841 (type).

PERÚ. *Madre de Dios:* near Avispes, FMNH 154831; La Unión, Carabaya, BMNH 1907.5.7.2; Itahauania, FMNH 81368; Mareapata, FMNH 62124, 62940.

Bachia flavescens flavescens

GUYANA: Kartabo UMMZ 65170.

Bachia flavescens schlegeli

GUYANA: Moraballi, on Río Essequibo BMNH 1930.10.10/167. No specific locality, SMF 39900 (type of *boettgeri*).

"INDIA": Calcutta (in error) RMNH 3580 (type of *schlegeli*).

Bachia heteropa alleni

GRENADA: Saint George, AMNH 38968, CAS 39462-63, USNM 43218-19; Amnandale Estate, USNM 79190; No specific locality, BMNH 96.6.5.1-2; USNM 67217, 67219-21.

GRENADINES: Bequia Island, Spring Estate, AMNH 90516.

SOUTH AMERICA: No specific locality, BMNH 53.2.4.68, 1961.1859; MNHM 2836.

TOBAGO: Easterfield road, NE of Mason Hall in the vicinity of milestone 2-3/4, USNM 167514; No specific locality, FMNH 55392.

Bachia heteropa heteropa

VENEZUELA: *Sucre:* 7.6 km S Junction Casanay, Capipito-Maturin road, KU 117099.

Bachia heteropa heteropa X *heteropa trinitatis*

VENEZUELA: *Sucre:* Capipito, (AMNH; Beebe field No. 30061?).

Bachia heteropa lineata

VENEZUELA: Caracas, RMNH 3579; Duaca, BMNH 1962.7.29.90; El Mené, north of Río Tocuya, BMNH 1928.12.12.8; Pauji, MZUSP 3010-11; San Estéban, Ravina de Palmas, UMMZ 55880.

Bachia heteropa trinitatis

TRINIDAD: Upper Arima Valley, AMNH 81486; Blanchiseuse, MCZ 55675; Brickfield, FMNH 49873-79, 49881-84, 49886-90, 49893, 49896-97; Caparo, AMNH 1608, 38815, CAS 39481-82; Chacachacare, MCZ 79117; Maracas Valley, MCZ 79819; Morne Bleu, AMNH 72852; Mt. Saint Benedict, FMNH 25013, 40000; Mt. Tucuche, MCZ 32521; Points—Pierre, MCZ 49062-63; Saint Augustine, FMNH 40447, 55390-91; Saint Mary's Gasparee Island, MCZ 79118; Tucker Valley, AMNH 64458 (3), 64522 (4); No specific locality, FMNH 10900.

VENEZUELA: Orinoco, RMNH 3578, MNHM 2837. *Sucre:* Cerro Azul, 10 km N Macuro, KU 133498-500, 133501 (2).

WEST INDIES: No specific locality, BMNH 1961.1860.

Bachia huallagana

PERÚ: *Huánuco:* 27.4 km SSE Aucayacu, UF 28143-44; Tingo María, USNM 192993-95, 193005-07; *San Martín:* San José de Tocache, USNM 192296-3004; upper Biabo Valley, AMNH 56566.

Bachia intermedia

PERÚ: *Cajamarca:* Bellavista, USNM 120787; 9 km S Jaén, LSUMZ 19381; 5 km SSE Jaén, MVZ 92867; Perico, AMNH 22730, 28438-59, BMNH 1946.8.31.94, CAS 54615, 54627, MCZ 14701-26; 28 km N Santa Cruz, LSUMZ 19382-416.

Bachia monodactylus monodactylus

BRASIL: *Amazonas,* Manáos, AMNH 64869-71, MZUSP, 471, 10912, 8353; Km 50, between Manáos and Itacotiara, MZUSP 8352. *Pará:* Ilhade Marajó, BMNH 1923.11.9.88; Rio Curuca, MCZ 3782.

CAYENNE: No specific locality, BMNH 53.11.22.16a-b, MNHM 2839, 2840a-b, 1899.76, 1903.229, 1928.109-110, 2838.

GUYANA: Bartica, AMNH 21269; Essequibo, BMNH 1970.714; Kaburi, MCZ 81179; Kamakusa, AMNH 25084-85; near mouth of Guyani River, BMNH 1930.10.10.166; Maccasuma, BMNH 87.1.22.8-9; New River, BMNH 1939.1.1.76-80; Pickersgill, USNM 85012; Potaro, BMNH 1970.713; Potaro Road, 82 mi S Bartica, BMNH 1934.11.1.106; Rupununi District, north of Acarahy Mts., KU 69801; No specific locality, AMNH 60911.

SURINAM: Albina, RMNH 13411; Brokopondo, RMNH 13413; Coppername, RMNH 15216; Maratakka, RMNH 13414; Marowijne

Basecamp, RMNH 13412a-b; near Papatam, RMNH 15217a-b; Sipaliwini, near Sipaliwini River, RMNH 16377; Sipaliwini, 5 km NW airstrip, RMNH 16434a-b; Sipaliwini, 4 km E airstrip, RMNH 15183; No specific locality, RMNH 3581.

VENEZUELA: Caracas, BMNH 51.7.17.4 (probably in error).

Bachia monodactylus parkeri

COLOMBIA: *Vaupés:* Río Tiquia USNM 65437.

GUYANA: Chenapowu River, on the upper Potaro River, BMNH 1946.8.42-43, MCZ 21685; Demerara, Lama Creek, FMNH 23807.

Bachia pallidiceps

COLOMBIA. *Antioquia:* Villa Arteaga, FMNH 78135. *Chocó:* Quesada River, Atrato region, AMNH 18230; Quibdó, BMNH 1909. 10.30.37.

PANAMÁ. *Chiriquí:* Puerto Armulles, ANSP 21773. *Darién:* Río Tuira at Río Mono, KU 96868-78; paradise Camp on Río Morti, FMNH 170025-26; Yavisa, MCZ 37750.

SOUTH AMERICA. No specific locality, MNHM 7051.

Bachia panoplia

BRASIL: *Amazonas:* Manáos, AMNH 64872-80, 64882, MZUSP 10910-11.

COLOMBIA: *Vaupés:* Timbo, MM R-3621.

Bachia peruana

PERÚ: *Ayacucho:* Between Petaccocha and San José, along the Río Santa Rosa, LSUMZ 25505-08. *Huánuco:* Río Llulla Pichis, AMNH 104278. *Junín:* Chanchamayo (Valley), AMNH 56560-63, FMNH 40585; Perené (Valley), AMNH 23212, 23214-15; San Ramón, FMNH 134399. *Loreto:* Colonia Calleria on Río Calleria, CAS 93215-32, 104365; Orellana, AMNH 56564; Roaboya, AMNH 56557-59, 56565.

Bachia scolecoides

BRASIL: *Mato Grosso:* Rio Teles Pires, AMNH 86955, MZUSP 3289-94.

Bachia talpa

COLOMBIA: *El Cesar:* Valledupar, UMMZ 54769-71. *La Guajira:* Fonseca, UMMZ 54768. *Magdalena:* Valencia, UMMZ 54772-73.

Bachia trisanale abendrothi

PERÚ: *Junín:* Chanchamayo Valley, MCZ 82898. *Loreto:* Balta, LSUMZ 25502-03; Orellana, USNM 127136; Río Ucayali Valley, near mouth of Río Cushabatay, AMNH 56576, 56581; Sarayacu, BMNH 1946.8.2.14 (syntype), 81.5.13.26-27, MCZ 21069; Selvas del Río, FMNH 40019; Yarinacocha, FMNH 45473, 55976-78, LSUMZ 25501, 25504; Pucallpa, FMNH 55979; no specific locality, AMNH 56582.

Bachia trisanale trisanale

ECUADOR: Napo or upper Marañón, ANSP 9637 (type); "oriente," UMMZ 82875. *Chimborazo:* Riobamba, AMNH 14574 (in error). *Morona-Santiago:* Macas, AMNH 38809; 2 mi E Sucua, USNM (JAP 2202). *Napo:* Lago Agrio, KU 126812-31, 126848, UMMZ 129344; Puerto Libre, 122194-95; Santa Cecilia, KU 126811; near Tena UMMZ, 84738. *Pastaza:* Limón, USNM (JAP 6900).

PERÚ: 5 km NE Aramargo, RT 286-87; Río Comania, Marañón Valley, AMNH 56580; Quaracayo Pongo, AMNH 56578. *Amazonas:* 15 km CW Chiriaco, RT 318-20, 416-17.

Bachia trisanale vermiformis

PERÚ: *Loreto:* Nauta, ANSP 11353 (type).

Bachia trisanale trisanale X trisanale vermiformis

PERÚ: *Loreto:* Iquitos, MCZ 123709; Mishana, TCWC 38117-18; Moropon, TCWC 36715, 39028; Río Itaya, AMNH 56567-75, 56577, 56579.

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